GATES LEARJET CORPORATION

maintenance manual

CHAPTER

22

AUTO FLIGHT

RECORD OF TEMPORARY REVISIONS

Rev. No.	Date Inserted	Date Removed	Page Number	Rev. No.	Date Inserted	Date Removed	Page Number
22-1	Oct 27/78	Jan 12/79 TR #22-2	22-50-00 Pg 203				
22-2	Jan 12/79	Dec 18/81 Rev #11	22-50-00 Pg 203				
22-3	Feb 12/79	Dec 18/81 Rev #11	22-50-00 Pg 202				
22-4	Nov 26/80	Dec 18/81 Rev #11	22-10-03 Pg 201				
22-5	Nov 26/80	Dec 18/81 Rev #11	22-10-03 Pg 202				
22-6	Jan 5/81	Dec 18/81 Rev #11	22-11-00 Pg 201				
22-7	Mar 20/81	Dec 18/81 Rev #11	22-10-00 Pg 208				

Chapter Section Subject	Page	Date
22-Title		
22-Record of Temp. Revisions		Dec 18/81
*22-List of Effective Pages	1	May 25/84
*22-List of Effective Pages	2	May 25/84
22-Contents	1	Dec 18/81
22-Contents	2	Aug 6/82
22-Contents	3	Aug 6/82
22-10-00	1	Aug 6/82
22-10-00	2	Aug 6/82
22-10-00	3	Dec 10/82
22-10-00	4	Dec 10/82
22-10-00	201	Dec 18/81
22-10-00	202	Dec 18/81
22-10-00	203	Dec 18/81
22-10-00	204	Dec 18/81
22-10-00	205	Dec 18/81
22-10-00	206	Dec 18/81
22-10-00	207	Dec 18/81
22-10-00	208	Dec 18/81
22-10-00	209	Dec 18/81
22-10-00	210	Dec 18/81
22-10-00	211	Dec 18/81
22-10-01	201	Dec 18/81
22-10-02	201	Dec 18/81
22-10-03	201	Dec 10/82
22-10-04	201	Dec 18/81
22-10-05	201	Dec 18/81
22-10-05	202	Dec 18/81
22-10-05	203	Dec 18/81
22-11-00	1	Dec 18/81
22-11-00	2	Dec 18/81
22-11-00	201	Dec 18/81
22-11-01	201	Dec 18/81
22-11-01	202	Dec 18/81
22-11-01	203	Aug 6/82
22-11-01	204	Dec 18/81
22-11-02	201	Dec 18/81
22-11-02	202	Dec 18/81
22-11-02	203	Dec 18/81
22-11-02	204	Dec 18/81
22-11-03	201	Dec 18/81
22-11-03	202	Dec 18/81
22-11-04	201	Dec 18/81
22-11-05	201	Dec 18/81
22-11-06	201	Dec 18/81
22-11-07	201	Dec 18/81
22-12-00	1	Aug 6/82
22-12-00	2	Aug 6/82
*22-12-01	201	May 25/84
*22-12-01	202	May 25/84
22-12-01	203	Aug 6/82
22-12-01	204	Dec 18/81
22-12-02	201	Dec 18/81
22-12-02	202	Dec 18/81
22-12-02	203	Dec 18/81
22-12-02	204	Dec 18/81
22-12-03	201	Aug 6/82
22-20-00	1	Dec 18/81
22-20-00	2	Dec 18/81
22-20-01	201	Dec 18/81
22-20-01	202	Dec 18/81
22-50-00	1	Aug 6/82
22-50-00	2	Aug 6/82
22-50-01	201	Dec 18/81
22-50-01	202	Dec 18/81
22-50-02	201	Dec 18/81
22-50-02	202	Dec 18/81
22-50-02	203	Dec 18/81
22-50-02	204	Aug 6/82
22-50-03	201	Dec 18/81
22-50-04	201	Dec 18/81
22-50-04	202	Aug 6/82
22-50-04	203	Dec 18/81
22-50-04	204	Dec 18/81
22-50-05	201	Aug 6/82

Insert Latest Revised Pages; Destroy Superseded or Deleted Pages.
*Asterisk indicates pages revised, added or deleted by current revision.
The portion of the text affected by the current revision is indicated by a vertical line in the outer margin of the page.

Chapter Section Subject	Page	Date
22-50-06	201	Dec 18/81
22-50-06	202	Dec 18/81
22-50-07	201	Dec 18/81
22-50-07	202	Dec 18/81
22-50-08	201	Dec 18/81
22-50-08	202	Dec 18/81
22-50-08	203	Dec 18/81
22-50-08	204	Dec 18/81
22-50-08	205	Dec 18/81
22-50-08	206	Dec 18/81
22-50-08	207	Dec 18/81
22-50-09	201	Dec 18/81
22-50-10	201	Dec 18/81
22-51-00	1	Aug 6/82
22-51-00	201	Aug 6/82
22-51-01	201	Aug 6/82
22-51-02	201	Aug 6/82
22-51-02	202	Aug 6/82

Chapter Section Subject	Page	Date

Subject	Chapter Section Subject	Page
AUTOPILOT - DESCRIPTION AND OPERATION	22-10-00	
Operation	22-10-00	1
Autopilot - Maintenance Practices	22-10-00	
Tools and Equipment	22-10-00	201
Adjustment/Test	22-10-00	201
Inspection/Check	22-10-00	210
Autopilot Controller - Maintenance Practices	22-10-01	
Removal/Installation	22-10-01	201
Autopilot Electrical Box - Maintenance Practices	22-10-02	
Removal/Installation	22-10-02	201
Autopilot Altitude Controller - Maintenance Practices	22-10-03	
Removal/Installation	22-10-03	201
Computer-Amplifier - Maintenance Practices	22-10-04	
Removal/Installation	22-10-04	201
Air Data Sensor - Maintenance Practices	22-10-05	
Removal/Installation	22-10-05	201
Inspection/Check	22-10-05	201
AUTOPILOT PITCH SYSTEM - DESCRIPTION AND OPERATION	22-11-00	
Description	22-11-00	1
Autopilot Pitch System - Maintenance Practices	22-11-00	
Inspection/Check	22-11-00	201
Autopilot Pitch Servo Actuator - Maintenance Practices	22-11-01	
Removal/Installation	22-11-01	201
Adjustment/Test	22-11-01	203
Pitch Followup - Maintenance Practices	22-11-02	
Removal/Installation	22-11-02	201
Adjustment/Test	22-11-02	201
Autopilot Pitch System Test Switch Relay Box - Maintenance Practices	22-11-03	
Removal/Installation	22-11-03	201
Autopilot Pitch System Blocking Diode - Maintenance Practices	22-11-04	
Removal/Installation	22-11-04	201
Pitch Servo Electric Box - Maintenance Practices	22-11-05	
Removal/Installation	22-11-05	201
Pitch Servo Interrupt Relay Box - Maintenance Practices	22-11-06	
Removal/Installation	22-11-06	201
Autopilot Disengage Printed Circuit Board - Maintenance Practices	22-11-07	
Removal/Installation	22-11-07	201

Subject	Chapter Section Subject	Page
AUTOPILOT ROLL SYSTEM - DESCRIPTION AND OPERATION	22-12-00	
Description	22-12-00	1
Autopilot Roll Servo Actuator - Maintenance Practices	22-12-01	
Removal/Installation	22-12-01	201
Adjustment/Test	22-12-01	203
Inspection/Check	22-12-01	203
Autopilot Roll Followup - Maintenance Practices	22-12-02	
Removal/Installation	22-12-02	201
Adjustment/Test	22-12-02	201
Autopilot Roll Monitor Control Box - Maintenance Practices	22-12-03	
Removal/Installation	22-12-03	201
MACH TRIM SYSTEM - DESCRIPTION AND OPERATION	22-20-00	
Description	22-20-00	1
Operation	22-20-00	1
Inspection/Check	22-20-00	2
Force Sensor - Maintenance Practices	22-20-01	
Removal/Installation	22-20-01	201
YAW DAMPER SYSTEM - DESCRIPTION AND OPERATION	22-50-00	
Description	22-50-00	1
Primary Yaw Damper Servo Actuator - Maintenance Practices	22-50-01	
Removal/Installation	22-50-01	201
Primary Yaw Damper Capstan Clutch - Maintenance Practices	22-50-02	
Removal/Installation	22-50-02	201
Adjustment/Test	22-50-02	201
Secondary Yaw Damper Servo Actuator - Maintenance Practices	22-50-03	
Removal/Installation	22-50-03	201
Secondary Yaw Damper Capstan Clutch - Maintenance Practices	22-50-04	
Removal/Installation	22-50-04	201
Adjustment/Test	22-50-04	201
Secondary Yaw Damper Controller	22-50-05	
Removal/Installation	22-50-05	201
Rudder Servo Sector - Maintenance Practices	22-50-06	
Removal/Installation	22-50-06	201

Subject	Chapter Section Subject	Page
Secondary Yaw Damper Servo Cable - Maintenance Practices	22-50-07	
Removal/Installation	22-50-07	201
Yaw Damper System Followups - Maintenance Practices	22-50-08	
Removal/Installation	22-50-08	201
Adjustment/Test	22-50-08	203
Yaw Rate Gyro - Maintenance Practices	22-50-09	
Removal/Installation	22-50-09	201
Yaw Damper Control Box - Maintenance Practices	22-50-10	
Removal/Installation	22-50-10	201
YAW DAMPER FORCE SENSOR SYSTEM - DESCRIPTION AND OPERATION	22-51-00	1
Description	22-51-00	1
Operation	22-51-00	
Yaw Damper Force Sensor System - Maintenance Practices	22-51-00	
Inspection/Check	22-51-00	201
Yaw Damper Force Detector Box - Maintenance Practices	22-51-01	
Removal/Installation	22-51-01	201
Yaw Damper Force Sensor - Maintenance Practices	22-51-02	
Removal/Installation	22-51-02	201

AUTOPILOT - DESCRIPTION AND OPERATION

1. Operation (See figure 1)
   A. The automatic flight control system (AFCS) will automatically fly the aircraft by holding the desired heading, attitude, and altitude. In addition, the AFCS can be used for capture and track of VOR/ILS radio beams and incorporates a backcourse feature.
   B. The AFCS consists of an autopilot controller, an autopilot electrical box, a yaw rate gyro, a lateral accelerometer, a vertical gyro, a directional gyro, a VOR/ILS navigation receiver, a computer/amplifier, on Aircraft 25-061, 25-070 thru 25-269 and 25-271, an autopilot altitude controller, and on Aircraft 25-270, 25-272 and Subsequent, an air data sensor.
   C. Commands to the AFCS are initiated by the roll turn knob, pitch command wheel, pedestal disconnect lever, Wheel Master Switch, Maneuver Control Switches, and mode pushbuttons. The roll turn knob and pitch command wheel are located on the autopilot controller. The pedestal disconnect lever is located between the throttle levers. The Maneuver Control Switches are mounted on the right horn of the pilot's control wheel and on the left horn of the copilot's control wheel. The Wheel Master Switch is located on the control wheels just below the Trim and Trim Arming Switch.
   D. The autopilot controller, mounted in the pedestal, contains the AFCS mode pushbuttons, roll (R) balance adjustment, primary yaw damper ON-OFF pushbuttons, and primary yaw damper (Y) balance adjustment. All mode pushbuttons are solenoid engaging type and, therefore, stay depressed once depressed until cancelled by other operations. The autopilot controller modes are as follows:
      (1) The autopilot amber (off) light will be illuminated anytime the autopilot has DC power available and is not engaged. The green (on) light will illuminate whenever the autopilot pitch and/or roll axes are engaged.
      (2) Depressing the ENGAGE pushbutton will engage the pitch and/or roll axes only and maintain heading hold function which will maintain wings level and aircraft heading. Autopilot is completely disengaged by activating any of the following:
         (a) Either Trim and Trim Arming Switch.
         (b) Either Wheel Master Switch.
         (c) Emergency Pitch Trim Switch.
         (d) Pilot's VG (vertical gyro) erect pushbutton.
         (e) Pilot's DG (directional gyro) slave pushbutton.
      (3) Depressing the HDG (heading) pushbutton activates the heading select function. This mode commands the aircraft to fly the heading selected by the Horizontal Situation Indicator (HSI). Depressing the HDG pushbutton will cancel NAV (navigation) and REV CRS (reverse course) modes, if engaged. Heading select mode is disengaged by turning the turn knob out of detent.

(4) Depressing the NAV (navigation) mode pushbutton activates the function which captures and tracks navigational radio beams such as VOR (variable omni range) and LOC (runway localizer). AFCS must be engaged and roll turn knob must be in the center detent position prior to NAV engagement. For NAV mode, the navigation receiver must be tuned to the discreet frequency of the selected navigation aid, and the course pointer on the HSI (horizontal situation indicator) must be set to the magnetic bearing of the selected radio beam.

(5) The REV CRS (reverse course) mode can be selected only after the NAV mode has been selected. REV CRS cannot be engaged if HDG is previously engaged. The front course localizer bearing must be set on the HSI prior to engaging this mode. Activating the REV CRS and NAV modes provides automatic intercept of 45° and automatic capture of the backcourse localizer in the same manner as for intercept and capture on a front course localizer. Turning the roll turn knob out of detent will disengage NAV and/or REV CRS modes. REV CRS is locked out on VOR frequency.

(6) Depressing the ALT (altitude hold) pushbutton will maintain the existing barometric altitude seen by the autopilot altitude controller. The G/S (glideslope) mode will be locked out when ALT is disengaged using the pitch command wheel.

(7) Depressing the G/S ARM (glideslope arm) pushbutton initiates the glideslope mode. The roll turn knob must be in the center detent position. The autopilot controller engages the glideslope immediately after the G/S ARM pushbutton, is depressed providing the systems are not in altitude hold. This method is referred to as manual engagement. The autopilot controller enters the automatic glideslope engage mode when the system is in altitude hold prior to depressing G/S ARM. The system remains in altitude hold until automatic glideslope engagement.

(8) Unless the roll turn knob is in the center detent position, the autopilot will not engage. Turning the roll turn knob hard-over in either direction will release the HDG, NAV, CRS REV, and G/S pushbuttons and the bank angle will be 30°.

(9) The pitch command wheel will command a maximum of 20° up or 10° down pitch attitude, and will release the G/S and/or ALT pushbuttons, if depressed.

(10) Depressing the YAW DAMPER-ON pushbutton engages the yaw damper. The yaw damper is disengaged by depressing the YAW DAMPER-OFF pushbutton. Activating either Wheel Master Switch will also disengage the yaw damper.

E. The pilot's and copilot's control wheels each contain a Wheel Master Switch, a Trim and Trim Arming Switch, and a Maneuver Control Switch. The Wheel Master Switch is a momentary-type switch, when depressed, will disengage all three axes of the autopilot. The Wheel Master Switch will also

disengage the yaw damper. The Maneuver Control Switch is a momentary-type switch which when depressed, momentarily disengages the pitch and roll axes of the autopilot. With the Maneuver Control Switch depressed, the aircraft can be flown manually with either control wheel. If a new attitude is established with the Maneuver Control Switch depressed, the autopilot will maintain this new pitch attitude and return to wings level when the switch is released.

F. A pedestal disconnect lever is located on the pedestal between the throttle levers. Depressing and holding the pedestal disconnect lever temporarily disengages the autopilot pitch axis while leaving the roll axis engaged. The aircraft can then be flown to a new pitch attitude and maintained at that attitude by the autopilot when the lever is released. Normal pitch trim may be used while depressing pedestal disconnect lever and autopilot will not disengage.

G. The autopilot electrical box houses electrical components necessary for the autopilot to interface with the stall warning and overspeed warning systems.

H. The computer-amplifier assembly sorts and mixes yaw, roll, and pitch axes signals to compute error signals. The error signals are used to control servo actuators positioning the aircraft control surfaces.

I. The aircraft is equipped with an autopilot servo actuator in each of the control surface axes. On signal from the autopilot, the servo actuators provide automatic roll, pitch, and yaw control to the aircraft.

J. The yaw rate gyro, installed in the nose compartment, initiates corrective action in the event of aircraft yawing. When the aircraft yaws, the yaw rate gyro provides a signal to the computer-amplifier which in turn corrects the yaw conditions.

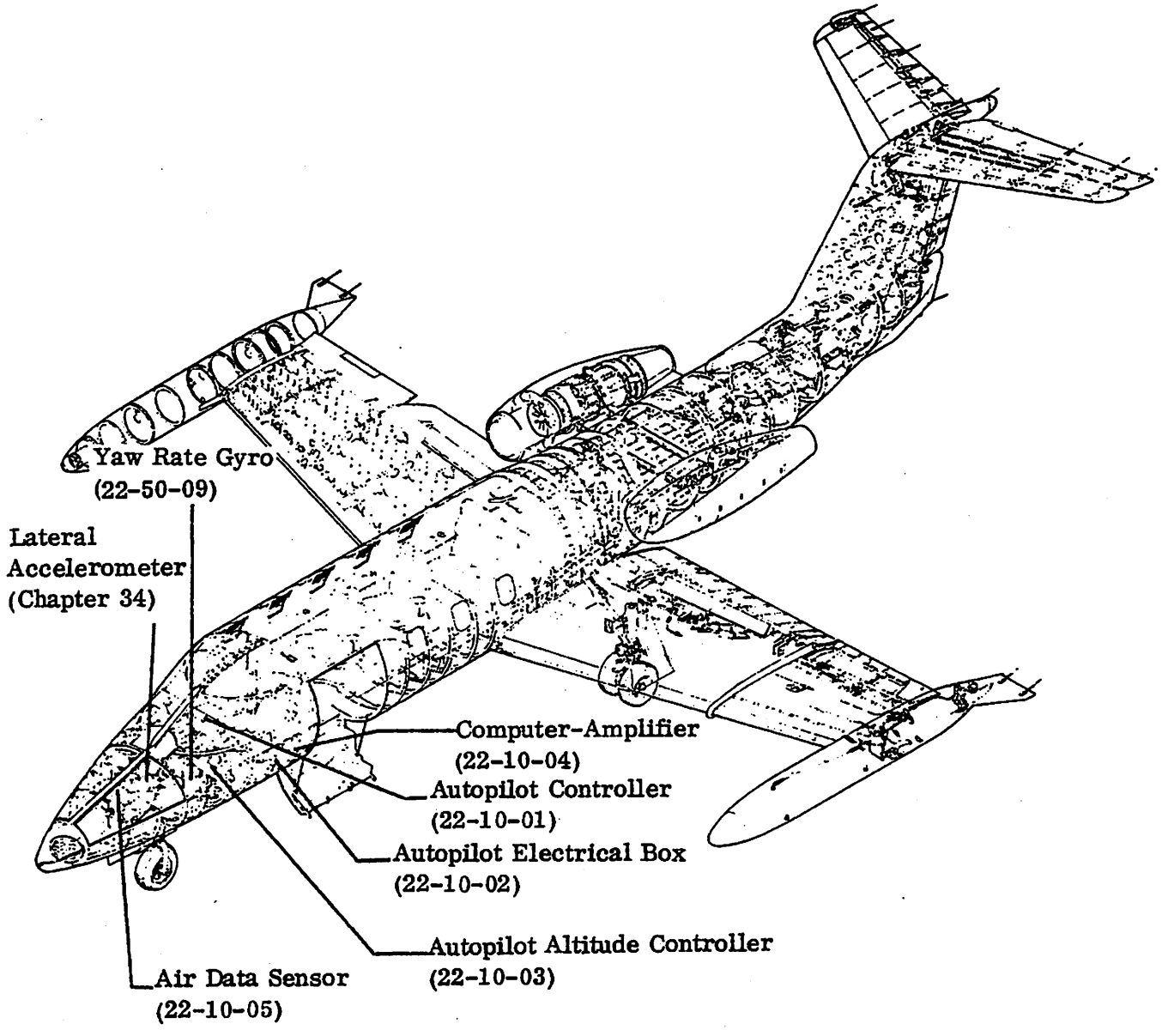
K. The lateral accelerometer, installed in the nose compartment, initiates corrective action to dampen aircraft movement in the event of yaw slipping or lateral accelerations. The accelerometer provides continuous rudder control through coordinated turns.

L. On Aircraft 25-061, 25-070 thru 25-269 and 25-271, an autopilot altitude controller is installed in the pilot's compartment at Frame 5. The autopilot altitude controller senses altitude changes through the shoulder static ports. The autopilot altitude controller converts the altitude changes into a voltage signal. This signal is then fed into the autopilot system to maintain the aircraft at a constant altitude.

M. On Aircraft 25-230 thru 25-341 and 25-343 thru 25-362 modified per AMK 81-12 (Installation of Engine Stall Warning Box and Air Data Sensor), the air data sensor provides airspeed (mach) and altitude information to the engine stall warning system. (Refer to Chapter 77.)

N. On Aircraft 25-270, 25-272 and Subsequent, an air data sensor is installed in the nose compartment just forward of the nose wheel well box. The air data sensor receives a static input from the shoulder static ports located just forward of the windshield. The pitot input is received from the copilot's (RH) pitot system. The air data sensor provides altitude hold, altitude rate, indicated airspeed (IAS), and standard true airspeed (Mach) output signals.

High altitude and low altitude switch outputs and synchronous air data output are also available. For overhaul and repair information, refer to AD-101A Air Data Computer Instruction Manual, Pub. No. TP-265, J.E.T. Electronics and Technology, Inc., 5353 52nd Street, Grand Rapids, Michigan 49508.



Component Location
Figure 1

AUTOPILOT - MAINTENANCE PRACTICES

1. Tools and Equipment

NAME	NUMBER	MANUFACTURER	USE
Tilt Table	TN 26410	Gates Learjet Corp.	Vertical Gyro
Turntable	TN 26409	Gates Learjet Corp.	Directional Gyro
Calibration Test Set	15-008	Gates Learjet Corp.	
VOR/ILS Simulator			
Extension Cable - Test Set			
Extension Cable - Directional Gyro			
Extension Cable - Vertical Gyro			
Voltmeter (VTVM)			
Pitot-Static Tester	Barfield 1811F		
Push-Type Spring Scale			

2. Adjustment/Test (See figure 201)

A. Prepare for functional testing as follows:

(1) Remove nose compartment doors.
(2) Remove primary vertical gyro from aircraft. (Refer to Chapter 34.)
(3) Install primary vertical gyro on tilt table and connect extension cable.
(4) Remove primary directional gyro from aircraft. (Refer to Chapter 34.)
(5) Install primary directional gyro on turntable and connect extension cable.
(6) Remove computer-amplifier. (Refer to 22-10-04.)
(7) Connect test set to aircraft and computer-amplifier.
(8) Connect pitot-static tester to autopilot altitude controller or air data sensor static line.
(9) Connect external power source to aircraft.
(10) With primary vertical and directional gyro and AFCS circuit breakers depressed, set Inverter and Battery Switch (es) on.
(11) Set Yaw and Roll W.O./SHORT Switches on computer-amplifier to SHORT.

B. Check Followup Phasing as follows:

NOTE: Followup voltages are ac.

(1) Position elevators, ailerons, and rudder to neutral.
(2) Gain access to pitch followup, located on aft elevator sector and accessible through aft LH tailcone access plate.
(3) Using a VTVM, check followup output signal. Rotate followup housing or rotate shaft to obtain minimum output voltage.
(4) Gain access to roll followup, located on LH aileron drive assembly and accessible through an access plate on lower LH wing.
(5) Using a VTVM, check followup output signal. Rotate following housing or rotate shaft to obtain minimum output voltage.
(6) Gain access to yaw followups, located adjacent to rudder servo sector and accessible through access plates on RH and LH aft lower vertical fin.
(7) Using a VTVM, check followup output signal. Rotate followup housing or rotate shaft to obtain minimum output voltage.
(8) Install safety wire on or apply Loctite to followup housing screws and followup shaft clamp screws.
(9) Install and secure access plates.
(10) Depress ENGAGE and YAW DAMPER/ON pushbuttons on autopilot controller.
(11) Override control column both fore and aft and release at each position. Control column shall return to neutral with a maximum of one overshoot. If column goes to mechanical stop and remains, followup is 180° out of phase.
(12) Override control wheel both right and left and release at each position. Control wheel shall return to neutral with a maximum of three overshoots. If wheel goes to mechanical stop and remains, followup is 180° out of phase.
(13) Override rudder pedals both right and left and release at each position. Rudder pedals shall return to neutral with a maximum of one overshoot. If pedal goes to mechanical stop and remains, followup is 180° out of phase.

C. Preset Computer-Amplifier Potentiometers as follows:

NOTE: The computer-amplifier potentiometers have eight notches on the face. These notches are used for presetting of potentiometers. Each notch is considered as having a value of one. As an example, a value of 3.5 would be set halfway between the third and fourth notch CW from the CCW stop.

PITCH		ROLL		YAW	
F.U.	2.5	F.U.	1.8	RATE GYRO	4.0
RATE GYRO	4.0	HDG	4.0	ACCEL	1.0
DISPL	4.0	DISPL	4.0	VEL GEN	3.0
VEL GEN	3.0	RATE GYRO	4.0	F.U.	2.0
		VEL GEN	3.0		

LATERAL COUPLER (SIGNAL)		LATERAL COUPLER (LOGIC)		LONGITUDINAL COUPLER	
HDG	2.8	DISPL	PRESET	G/S	4.0
BEAM	8.0	CRS	PRESET	ALT	1.2
RATE	1.5				
LIMIT	4.0				

TRIM COUPLER		ROLL CALIBRATION		PITCH CALIBRATION	
HIGH	4.0	TURN LIMIT	2.9	COUPLER LIMIT	PRESET
LOW	6.0	COUPLER LIMIT	4.5		

D. Functionally Test Yaw Axis as follows:

(1) Depress YAW DAMPER/ON pushbutton on autopilot controller to engage yaw damper.

(2) Center rudder servo force indicator by turning yaw balance potentiometer (Y) located through hole below and left of autopilot controller roll turn knob.

(3) Overpower each rudder pedal in turn. Servo force indicator shall indicate same direction as overpower. When rudder pedals are released, they shall center with no more than one overshoot. More than one overshoot can be corrected by decreasing the YAW F.U. potentiometer setting and/or increasing YAW VEL GEN potentiometer setting.

(4) With rudder pedals centered, observe primary and secondary yaw servo clutch currents on test set. Readings for both clutches shall be equalized with a slight overpower force on rudder pedals. Clutch current shall read less than 10 MA.

(5) If an indication of clutch current oscillation is observed, it can be corrected by adjusting YAW F.U. potentiometer and/or YAW VEL GEN potentiometer. High-frequency oscillation of rudder pedals indicates that YAW F.U. setting is too low or YAW VEL GEN setting is too low or YAW F.U. setting is too high.

(6) If any adjustment to YAW VEL GEN or F.U. potentiometers was necessary, then again overpower each rudder pedal in turn and check for a maximum of one overshoot when pedal is released.

(7) Depress YAW DAMPER/ON pushbutton on autopilot controller. Push tail of aircraft sideways while observing rudder. First rudder movement shall be in the direction of push on the tail. This will verify proper rate gyro phasing.

(8) Remove lateral accelerometer from its mount in nose compartment. Tilt accelerometer to approximately a 15° banked right turn. The system shall initiate right rudder, verifying correct lateral accelerometer phasing.

E. Functionally Test Roll Axis as follows:

(1) Depress ENGAGE pushbutton on autopilot controller.

(2) Center aileron servo force sensor indicator by turning roll balance (R) potentiometer located below and right of roll turn knob on autopilot controller.

(3) Overpower control wheel in each direction. Servo force indicator shall indicate same direction as overpower. When control wheel is released, it shall return to neutral by decreasing ROLL F.U. potentiometer setting and/or increasing ROLL VEL GEN potentiometer setting.

(4) With control wheel centered, monitor roll servo clutch currents on test set. Current for both clutches shall equalize with a slight overpower force. Clutch current shall be less than 10 MA.

(5) If an indication of clutch current oscillation is observed, it can be corrected by adjusting ROLL F.U. potentiometer and/or ROLL VEL GEN potentiometers. High-frequency oscillation indicates that ROLL F.U. potentiometer setting is too low. A low-frequency oscillation indicates that ROLL VEL GEN potentiometer setting is too low or ROLL F.U. potentiometer setting is too high.

(6) If any adjustment to ROLL potentiometers was necessary, again overpower control wheel in each direction and check for a maximum of one overshoot.

(7) Engage heading function on flight director and turn HDG knob on course indicator until heading marker is 90° off indicated course.

(8) Tilt vertical gyro approximately 25° in turn direction commanded by heading marker until flight director indicator indicates no further bank.

(9) Depress HDG pushbutton on autopilot controller.

(10) Adjust ROLL CALIBRATION COUPLER LIMIT potentiometer in computer-amplifier to streamline ailerons.

(11) Rotate roll turn knob, on autopilot controller, in same direction as heading marker indication. Ailerons should be approximately streamlined with roll turn knob rotated to stop and gyro tilted 30°.

(12) Adjust ROLL CALIBRATION TURN LIMIT potentiometer, in computer-amplifier, to streamline ailerons.

(13) Repeat steps (7) through (12) for a 90° turn in the opposite direction.

(14) Level the vertical gyro and depress NAV pushbutton on autopilot controller.

(15) Rotate COURSE knob on course indicator so that course indicator indicates a right turn. Control wheel shall rotate to a right turn configuration.

(16) Repeat steps (14) and (15) for a left turn.

(17) With tuner on LOC frequency, depress NAV and REV CRS pushbuttons on autopilot controller.

(18) Rotate COURSE knob on course indicator so that course arrow indicates a right turn. Control wheel shall rotate to a left turn configuration.

(19) Rotate COURSE knob so that course arrow indicates a left turn. Control wheel shall rotate to a right turn configuration.

(20) Disengage autopilot controller functions.

(21) Depress autopilot controller ENGAGE pushbutton.

(22) Rotate directional gyro to indicate a right turn. Control wheel shall rotate to a left turn configuration.

(23) Rotate directional gyro to indicate a left turn. Control wheel shall rotate to a right turn configuration.

NOTE: Steps (22) and (23) shall be performed as quickly as possible.

(24) Straighten directional gyro.

F. Functionally Test Pitch Axis as follows:

(1) With AFCS disengaged and control column in neutral, pitch servo effort indicator shall be centered.

(2) Deflect control column slightly forward and aft. Pitch servo effort indicator needle shall remain centered within one bar width.

(3) Set horizontal stabilizer for elevator neutral.

(4) Depress ENGAGE pushbutton on autopilot flight controller.

(5) Move control column forward and release it. Servo effort indicator shall indicate down and control column shall return to neutral with a maximum of one overshoot.

(6) Move control column aft and release it. Servo effort indicator shall indicate up and control column shall return to neutral with a maximum of one overshoot.

(7) If more than one overshoot is observed, correct by decreasing PITCH F.U. potentiometer setting and/or increasing PITCH VEL GEN potentiometer setting.

(8) Hold control column while observing servo clutch current meter on test set. Move control column until meter readings are equalized. Meter readings shall be less than 10 MA.

(9) If an indication of clutch current oscillation is observed, it can be corrected by adjusting the PITCH F.U. potentiometer and/or PITCH VEL GEN potentiometers. High-frequency oscillation indicates PITCH VEL GEN potentiometer setting is too high or that PITCH F.U. setting is too low. A low-frequency oscillation indicates PITCH VEL GEN

potentiometer setting is too low or that PITCH F.U. potentiometer setting is too high.

(10) If any adjustment to pitch potentiometers was necessary, again overpower control column in each direction and check for a maximum of one overshoot.

(11) Tune in a localizer frequency on NAV 1 and depress NAV pushbutton on autopilot controller.

NOTE: This step will prevent trim disconnect circuit from disengaging trim.

(12) Slowly move control column forward until Trim Up light on test set flashes. Trim Up light shall begin to flash when down clutch current on servo clutch meter indicates 18 (±2) MA.

(13) Move control column to obtain a clutch meter reading of 20 MA. Trim Up light shall flash approximately once ever 3 seconds.

(14) Move control column to forward stop. Trim Up light shall flash at approximately 1/3-second intervals. Verify that trim position indicator shows nose up position.

(15) Slowly move control column aft until Trim Down light on test set flashes. Trim Down light shall begin flashing when up clutch current meter indicates 18 (±2) MA.

(16) Move control column to obtain a clutch meter reading of 20 MA. Trim Down light shall flash approximately once every 3 seconds.

(17) Move control column to aft stop. Trim Down light shall flash at approximately 1/3-second intervals. Verify that trim position indicator shows nose down position.

(18) Return control column to neutral.

(19) Rotate pitch command wheel on the autopilot controller to UP. Control column shall move aft.

(20) Rotate pitch command wheel to DN. Control column shall move forward.

(21) Return pitch command wheel to center detent position.

(22) Tilt vertical gyro to simulate a nose up condition. Control column shall move forward.

(23) Tilt vertical gyro to simulate a nose down condition. Control columm shall move aft.

(24) Level vertical gyro. Control column shall return to neutral.

(25) Simulate an altitude of 10,000 feet using the pitot-static tester.

(26) Depress ALT pushbutton on autopilot controller. There shall be no more than 1/8-inch control column deflection when ALT is engaged.

(27) Increase simulated altitude to 10,050 feet. Control column shall move forward.

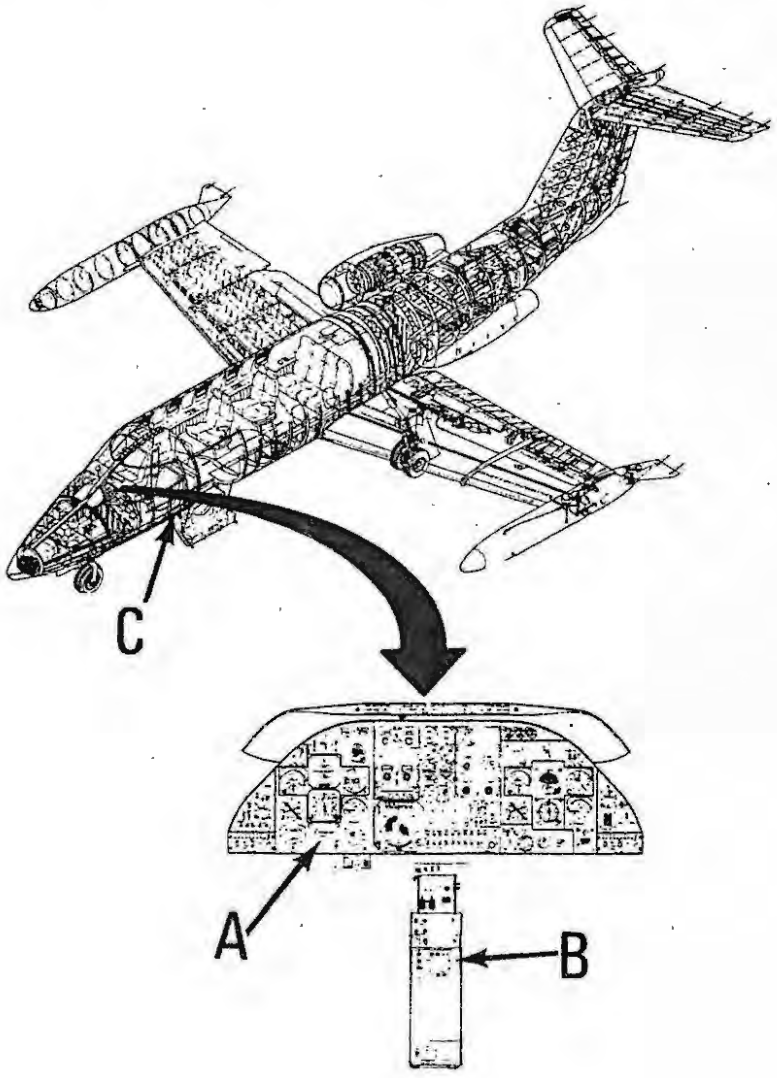
(28) Decrease altitude to 9,050 feet. Control column shall move aft.

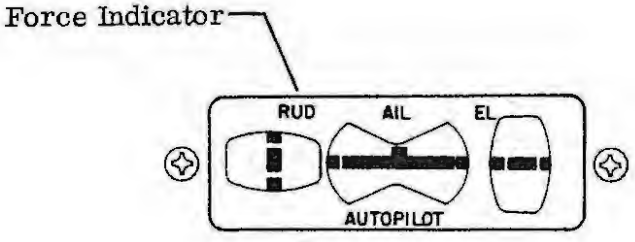
(29) Disengage ALT and remove pitot-static tester.

(30) Tune navigation receiver to a localizer frequency. Cause a G/S up indication with either a battery box or an ISL radio simulator.
(31) Depress ALT and G/S ARM pushbutton on autopilot pushbutton controller.
(32) Reduce G/S up indicator to zero. The ALT pushbutton shall disengage when G/S needle is between zero and one needle width above zero.
(33) Again cause a G/S indication. Control column shall move aft.
(34) Cause a G/S down indication. Control column shall move forward
(35) Disengage G/S ARM pushbutton on autopilot controller.

G. Calibrate AFC/SS System as follows:

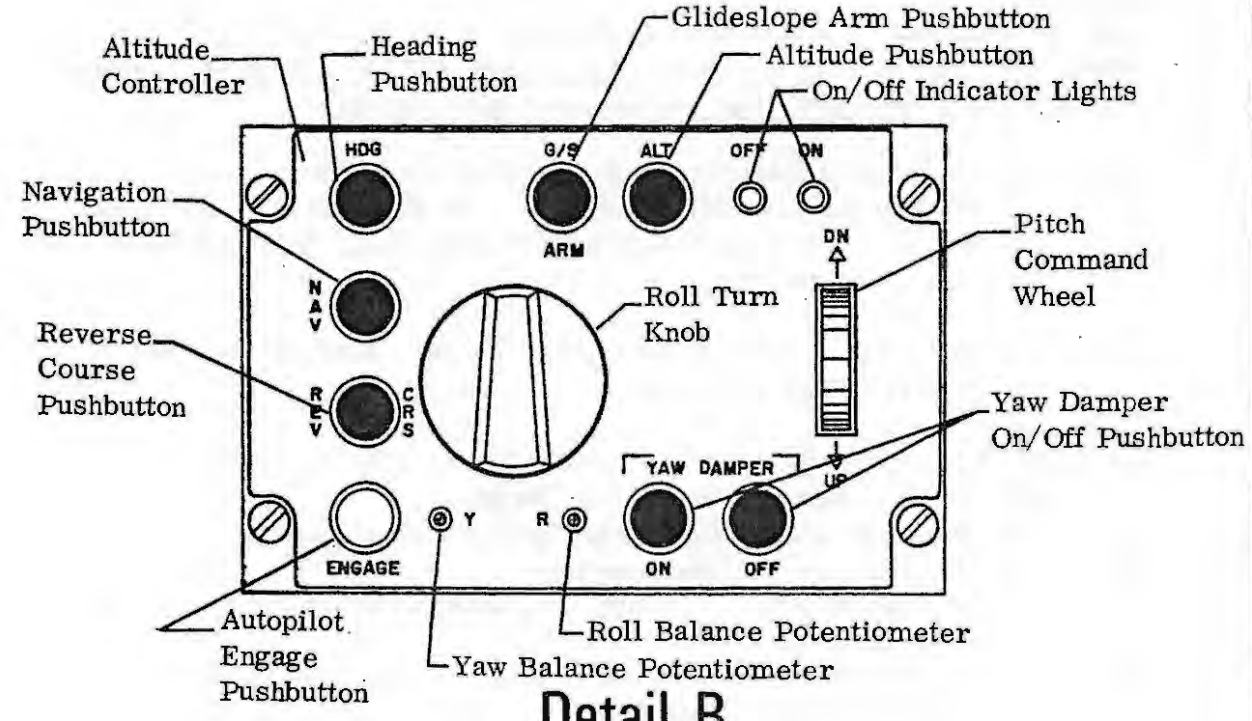
(1) Set horizontal stabilizer to 0°30' leading edge nose down position and secure elevators in streamline neutral position.
(2) Depress HDG pushbutton on autopilot controller.
(3) Using a push-type spring scale held firmly against control wheel just below hub, push control column forward to obtain a scale reading of 8 (±1) pounds.
(4) Adjust TRIM DISCONNECT TRIP potentiometer in computer-amplifier until the HDG pushbutton disengages.
(5) Return control column to neutral and again depress HDG pushbutton.
(6) Push control column aft using spring scale. HDG pushbutton shall disengage when 8 (±1) pounds force is reached.
(7) Correct any difference in fore and aft force by adjusting Trim Disconnect balance potentiometer. The TRIP potentiometer may have to be readjusted to obtain 8 (±1) pounds both fore and aft.
(8) Free elevators and again check force required to disengage ALT pushbutton. Force, both fore and aft, must be 8 (±1) pounds.
(9) With ENGAGE pushbutton on autopilot controller disengaged, engage AFC/SS Test Switch on pedestal. Overspeed warning horn will sound.
(10) Depress ENGAGE pushbutton and again engage AFC/SS Test Switch. No warning will sound.
(11) Depress HDG and ALT pushbuttons on autopilot controller.
(12) Pull control column aft. ALT and HDG pushbuttons will disengage.
(13) Set Battery and Inverter Switches to OFF.
(14) Set YAW and ROLL W.O./SHORT Switches to W.O.
(15) Disconnect external power source.
(16) Install all equipment previously removed from aircraft.



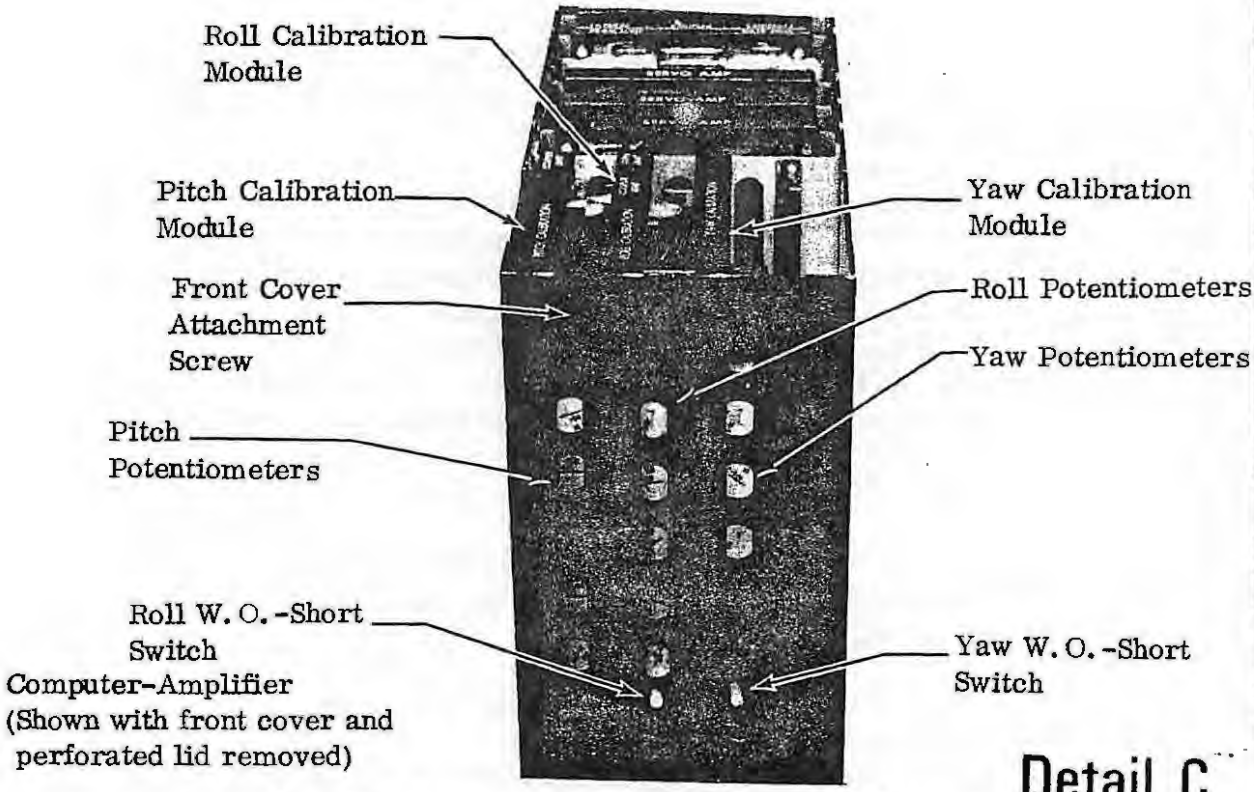


Detail A

Autopilot Controls, Potentiometers, and Indicators
Figure 201 (Sheet 1 of 2)



Detail B



Detail C

Autopilot Controls, Potentiometers, and Indicators
Figure 201 (Sheet 2 of 2)

3. Inspection/Check

A. Perform Automatic Flight Control/Stability System (AFC/SS) Operational Check. (Aircraft 25-337, 25-342 and Subsequent, and Prior Aircraft Modified for Horizontal Stabilizer Trim and Autopilot Improvement)

NOTE: • The autopilot disengage tone will sound whenever the autopilot pitch and roll axes are disengaged. The tone will not sound when the roll and/or pitch axes are interrupted using the Maneuver or Pitch Sync Switches.

• Allow 90 (±20) seconds for Course Indicator HDG and Vertical Gyro OFF flags to disappear.

(1) Hold AFC/SS TEST Switch (forward pedestal) to TEST; aural warning shall sound. Release AFC/SS TEST Switch.
(2) Check that bars are centered on autopilot force indicators.
(3) Turn command knob to detent position.
(4) Depress autopilot ENGAGE pushbutton; autopilot control head ENGAGE light shall illuminate.
(5) Hold AFC/SS TEST Switch to TEST; aural warning shall not sound. Release AFC/SS TEST Switch.
(6) Autopilot Roll Monitor Check:
  (a) Engage PRI or SEC Yaw Damper.
  (b) Depress and hold A/P TEST-ROLL MON Switch (forward pedestal); Autopilot pitch and roll axes shall disengage within eight seconds.
(7) Autopilot Trim Monitor Check
  (a) Depress autopilot ENGAGE pushbutton.
  (b) Hold A/P TEST-TRIM MON Switch (forward pedestal) to UP; Autopilot pitch and roll axes shall disengage within five seconds. Release A/P TEST-TRIM MON Switch.
  (c) Depress Autopilot ENGAGE pushbutton.
  (d) Hold A/P TEST-TRIM MON Switch to DN; Autopilot pitch and roll axes shall disengage within five seconds. Release A/P TEST-MON Switch.
(8) Autopilot Trim Check

NOTE: It is recommended that the horizontal stabilizer be placed in approximately the takeoff trim position before beginning this check.

(a) Assure that Autopilot ENGAGE pushbutton is off.
(b) Push Control Column full forward.
(c) Depress Autopilot ENGAGE pushbutton.
(d) Depress ALT pushbutton.

(e) Rotate pitch command wheel in DN direction, hold until nose-down trim movement occurs; trim audio clicker may or may not sound. ALT pushbutton will disengage when pitch command wheel is rotated.
(f) Autopilot ENGAGE pushbutton is off.
(g) Pull control column full aft.
(h) Depress Autopilot ENGAGE pushbutton.
(i) Depress ALT pushbutton.
(j) Rotate pitch command wheel in UP direction and hold until nose-up trim movement occurs; trim audio clicker may or may not sound. The ALT pushbutton will disengage when the pitch command wheel is rotated.

(9) Depress HDG and ALT pushbuttons.

(10) Depress SPD pushbutton (if installed). ALT pushbutton will return to OFF position.

(11) Rotate pitch command wheel left then right. HDG pushbutton will return to the OFF position and control wheel will follow.

(12) Rotate pitch command wheel DN then UP. SPD pushbutton (if installed) or ALT pushbutton will return to the off position and control column will move forward then aft.

(13) Autopilot Disengagement Check
(a) Engage PRI or SEC Yaw Damper.
(b) Depress ALT or SPD (if installed) pushbutton.
(c) Depress Pitch Sync Switch (throttle quadrant), check function, then release. ALT or SPD (if installed) mode shall disengage. The autopilot pitch axis shall disengage while Pitch Sync Switch is held.
(d) Depress HDG and ALT pushbuttons.
(e) Depress Pilot's or Copilot's Maneuver Switch, check function, then release. HDG and ALT modes shall disengage when Maneuver Switch is depressed. The autopilot pitch and roll axes (attitude hold) shall disengage while Maneuver Switch is held.
(f) Operate pilot's or copilot's control wheel trim switch NOSE UP or NOSE DN. Autopilot shall disengage (autopilot horn shall sound).
(g) Depress Autopilot ENGAGE pushbutton.
(h) Depress pilot's and copilot's Control Wheel Master Switch. Autopilot and yaw damper shall disengage (autopilot horn shall sound).

AUTOPILOT CONTROLLER - MAINTENANCE PRACTICES

1. Removal/Installation

   A. Remove Autopilot Controller (See figure 201)

      (1) Remove electrical power from aircraft.

      (2) Release quick-attach fasteners and remove autopilot controller from pedestal sufficiently to disconnect connector.

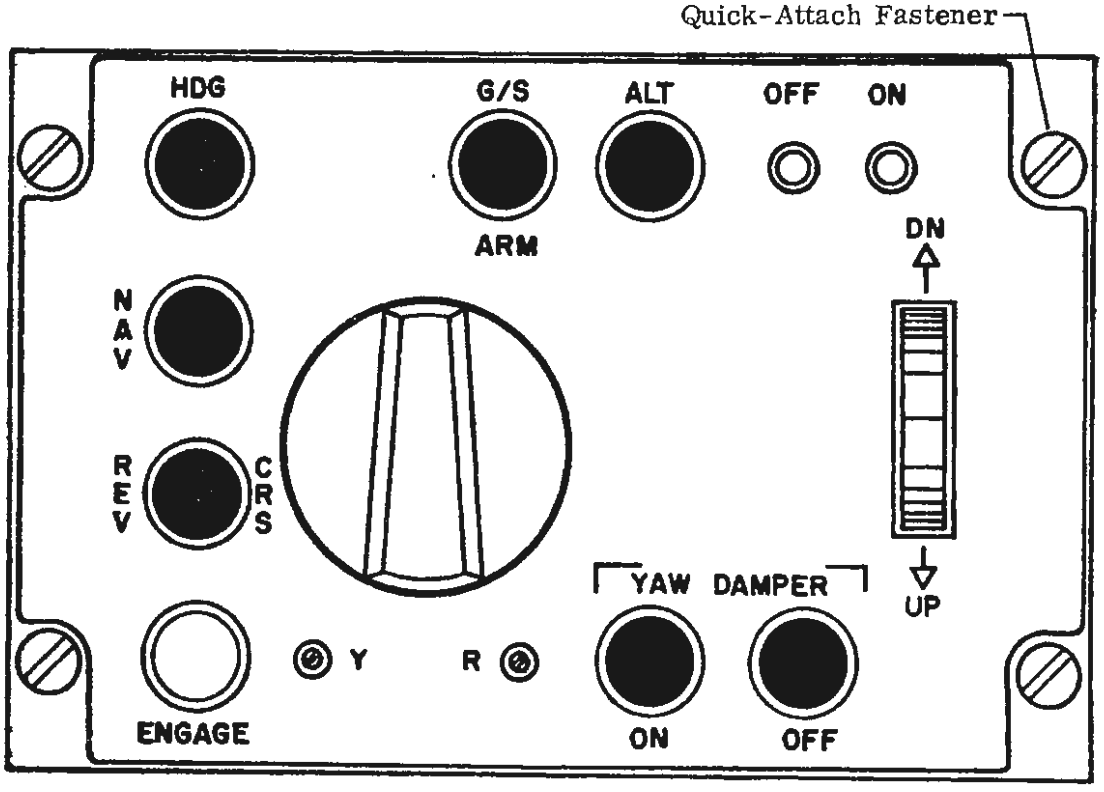
      (3) Disconnect electrical connector and remove controller from pedestal.

   B. Install Autopilot Controller (See figure 201)

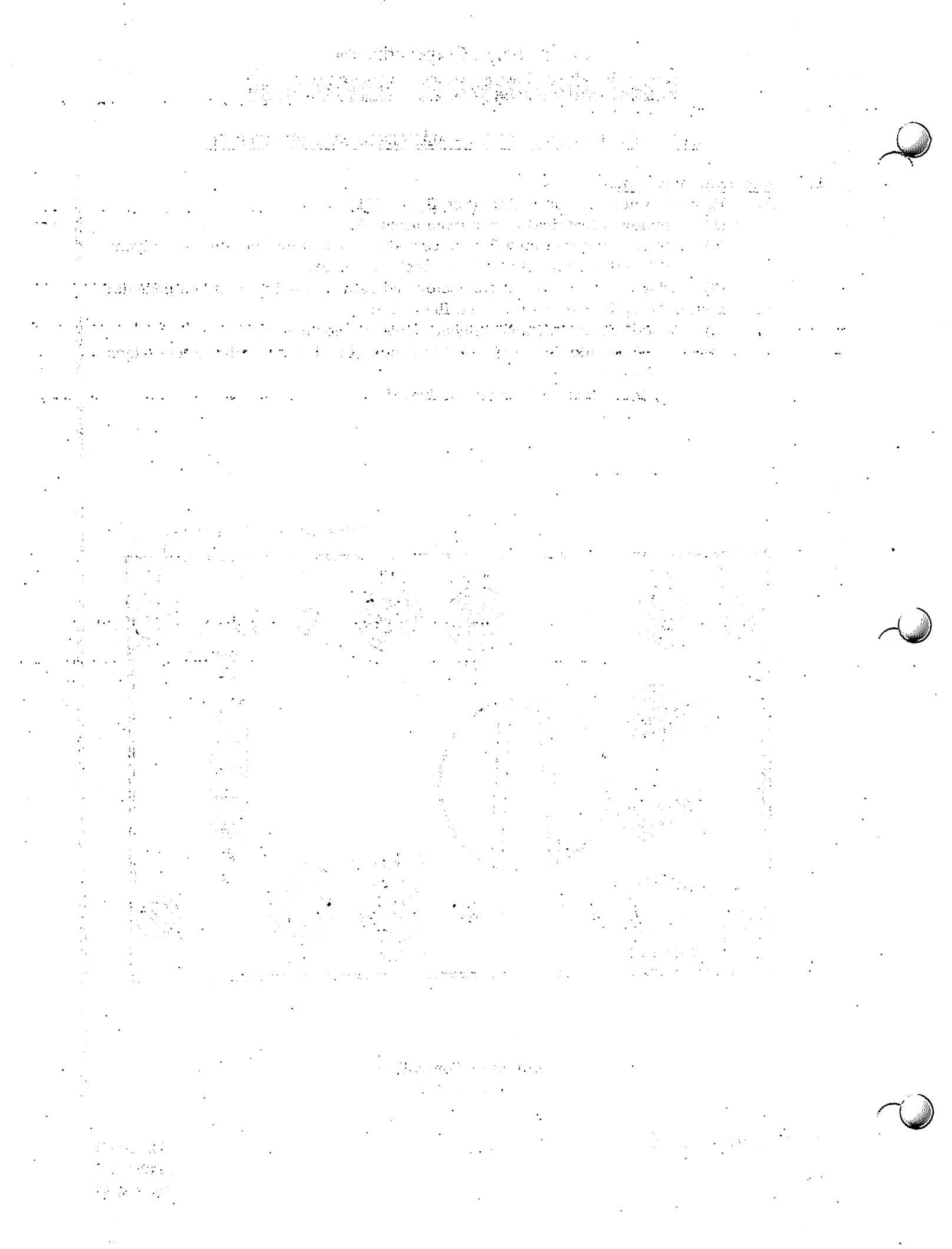
      (1) Install controller and connect electrical connector.

      (2) Position autopilot controller in pedestal and secure with quick-attach fasteners.

      (3) Restore electrical power to aircraft.



Autopilot Controller
Figure 201



AUTOPILOT ELECTRICAL BOX - MAINTENANCE PRACTICES

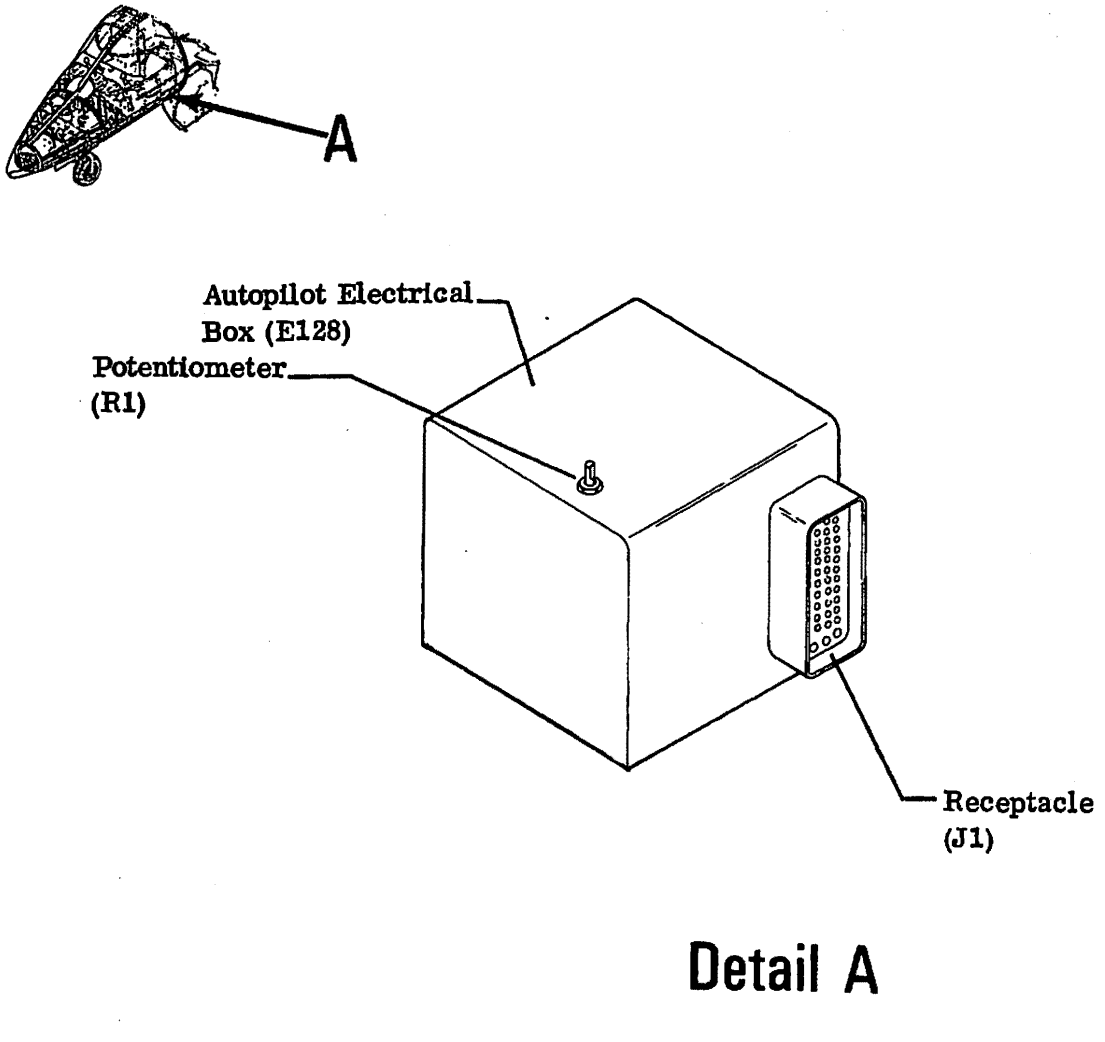
1. Removal/Installation

A. Remove Autopilot Electrical Box (See figure 201)

(1) Remove electrical power from aircraft.
(2) Disconnect electrical connector from the autopilot electrical box.
(3) Remove both screws securing electrical box to autopilot rack.
(4) Remove electrical box from rack.

B. Install Autopilot Electrical Box (See figure 201)

(1) Position electrical box on autopilot rack and align screw holes.
(2) Install both attachment screws.
(3) Connect electrical connector to the autopilot electrical box.
(4) Restore electrical power to aircraft.



W9-108C

Autopilot Electrical Box Installation
Figure 201

AUTOPILOT ALTITUDE CONTROLLER - MAINTENANCE PRACTICES

1. Removal/Installation

A. Remove Autopilot Altitude Controller (See figure 201)

(1) Remove electrical power from aircraft.

(2) Remove equipment as necessary to gain access to the altitude controller.

(3) Disconnect electrical connector and static plumbing from altitude controller.

(4) Remove attaching parts and altitude controller from aircraft.

B. Install Autopilot Altitude Controller (See figure 201)

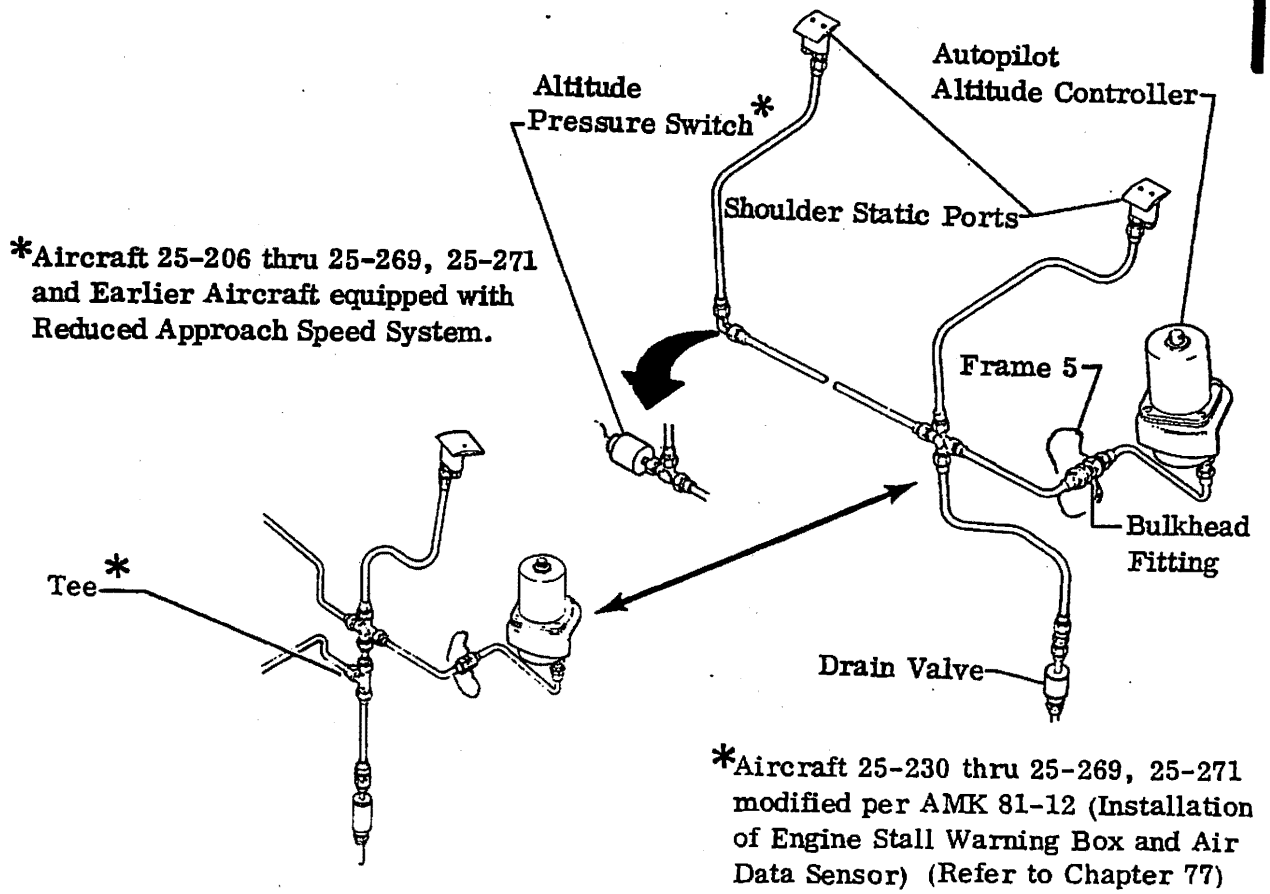
(1) Position altitude controller in mounting bracket, align screw holes, and secure with attaching parts.

(2) Connect static plumbing to altitude controller.

(3) Connect electrical connector to altitude controller.

(4) Reinstall any equipment which may have been removed to gain access to altitude connector.

(5) Restore electrical power to aircraft.



*Aircraft 25-206 thru 25-269, 25-271 and Earlier Aircraft equipped with Reduced Approach Speed System.

*Aircraft 25-230 thru 25-269, 25-271 modified per AMK 81-12 (Installation of Engine Stall Warning Box and Air Data Sensor) (Refer to Chapter 77)

Autopilot Altitude Controller Installation
Figure 201

W9-24B-1
14-130C-1

COMPUTER-AMPLIFIER - MAINTENANCE PRACTICES

1. Removal/Installation

A. Remove Computer-Amplifier (See figure 201)

(1) Remove electrical power from aircraft.

(2) Gain access to computer-amplifier located between frames 8 and 9 at LBL 7.

(3) Disconnect electrical connectors from computer-amplifier.

(4) Remove attaching parts and computer-amplifier from aircraft.

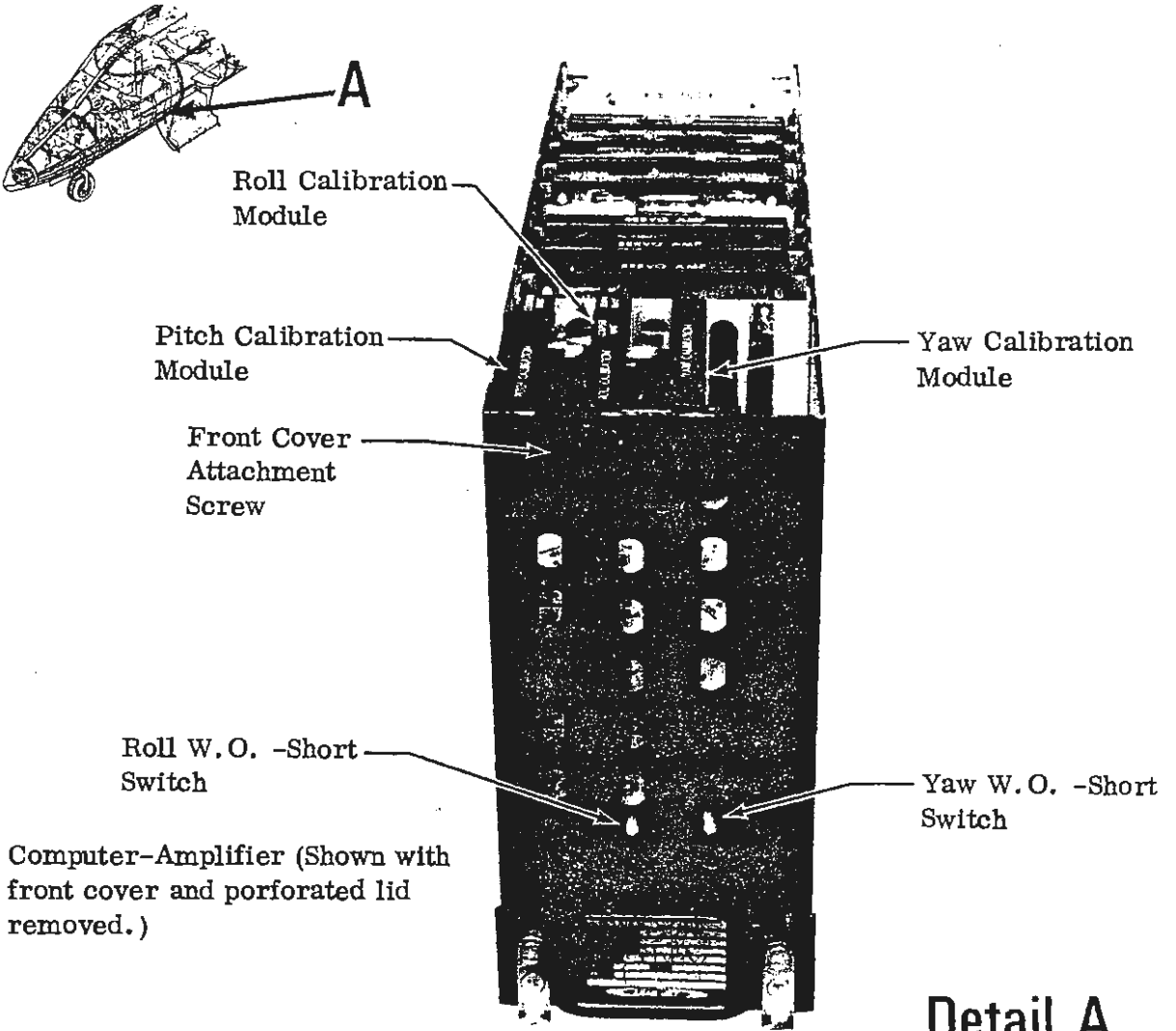
B. Install Computer-Amplifier (See figure 201)

(1) Place computer-amplifier in position and secure with attaching parts.

(2) Connect electrical connectors to computer-amplifier.

(3) Install equipment removed to gain access to computer-amplifier.

(4) Restore electrical power to aircraft.



Computer-Amplifier Installation
Figure 201

AIR DATA SENSOR - MAINTENANCE PRACTICES

1. Removal/Installation
   - A. Remove Air Data Sensor (See figure 201)
     - (1) Remove electrical power from aircraft.
     - (2) Remove nose compartment access doors.
     - (3) Disconnect pitot and static lines from sensor. Cap all exposed lines.
     - (4) Disconnect electrical connector from sensor.
     - (5) Remove attaching parts and sensor from aircraft.
   - B. Install Air Data Sensor (See figure 201)
     - (1) Install air data sensor and secure with attaching parts.
     - (2) Remove caps from previously capped pitot and static sources. Connect pitot and static hose assemblies to applicable fittings on sensor.
     - (3) Connect electrical connector to sensor.
     - (4) Perform leakage check of pitot and static lines.
     - (5) Install nose compartment access doors.
     - (6) Restore electrical power to aircraft.

2. Inspection/Check
   - A. Perform Pitot Leakage Check
     - (1) Connect pitot-static tester to copilot's (RH) pitot system.

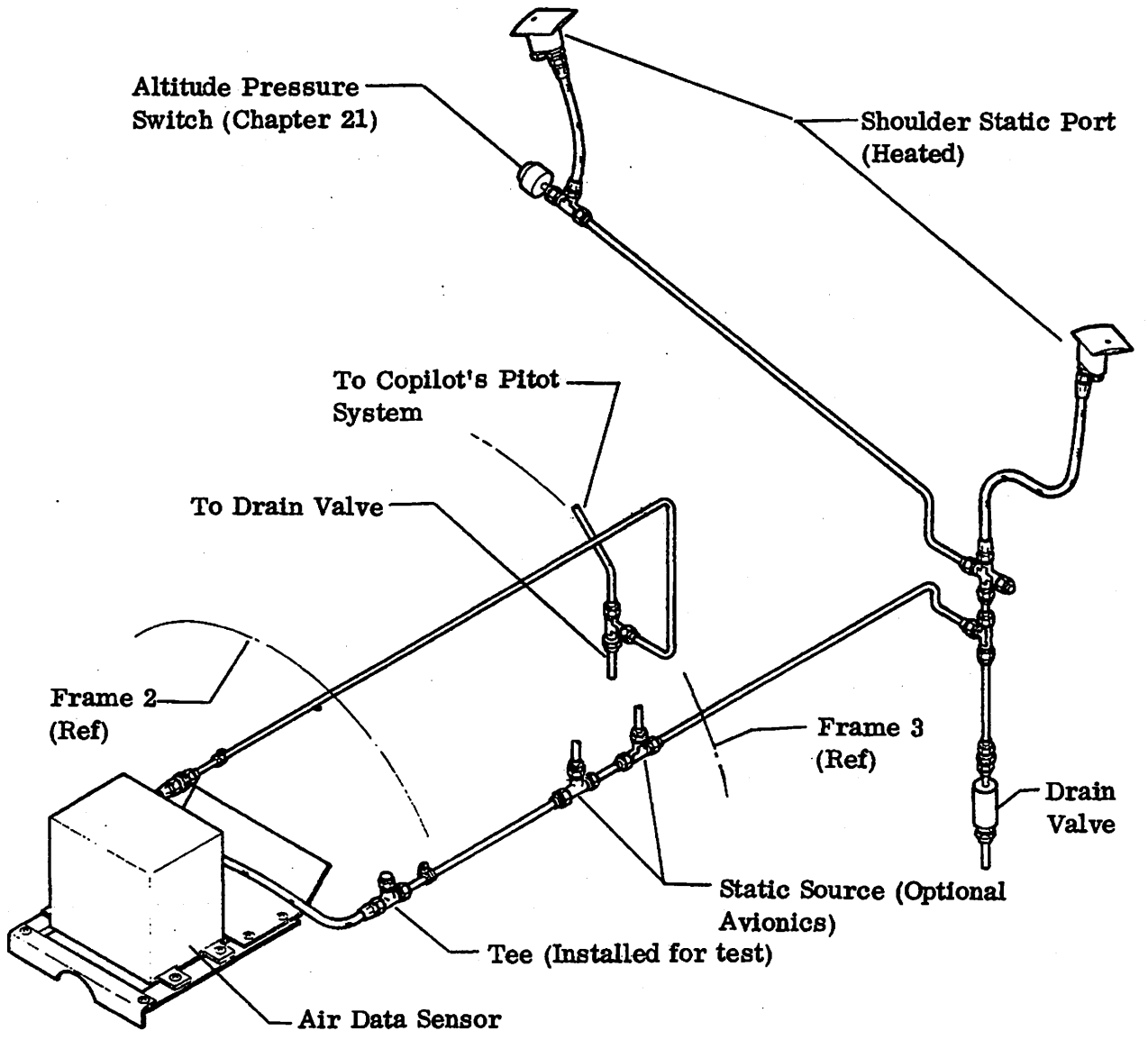
       CAUTION: APPLY ONLY PRESSURE (NOT VACUUM) TO THE PITOT SYSTEM. APPLY PRESSURE VERY SLOWLY UNTIL 80 KNOTS IS REACHED; PRESSURE APPLICATION AFTER THIS POINT MUST NOT EXCEED 20 KNOTS PER SECOND.

       NOTE: Refer to Chapter 34 for general pitot-static system maintenance practices.

     - (2) Slowly apply pressure until copilot's airspeed indicator indicates 300 knots. Rate of pressure increase shall not increase airspeed indicator in excess of 20 knots per second after 80 knots is reached.
     - (3) Turn off pressure sealing system. System pressure shall not drop in excess of 5 knots in 5 minutes.

       CAUTION: DEPRESSURIZATION RATE SHALL NOT EXCEED 20 KNOTS PER SECOND OR INSTRUMENT DAMAGE COULD RESULT.

     - (4) Slowly release pressure from copilot's pitot system and remove pitot-static tester.



Air Data Sensor System Installation
Figure 201

B. Perform Static Leakage Check

CAUTION:
- APPLY VACUUM TO SHOULDER STATIC PORTS, CO-PILOT'S (RH) PITOT SYSTEM AND TO COPILOT'S STATIC SYSTEM WHEN PERFORMING AIR DATA LEAKAGE CHECK.
- THE COPILOT'S PITOT SYSTEM IS COMMON TO BOTH THE AIR DATA SENSOR AND THE COPILOT'S INSTRUMENTS. THEREFORE, WITH THE APPLICATION OF VACUUM AT THE PITOT SOURCE A SEVERE PRESSURE DIFFERENTIAL COULD RESULT AND DAMAGE THE INSTRUMENTS.

(1) Connect pitot-static tester to shoulder static ports, copilot's static system, and copilot's pitot system.

CAUTION: APPLY ONLY VACUUM (SUCTION) DURING THIS CHECK AND ASSURE THAT THE TEST SET CROSS-BLEED IS OPEN.

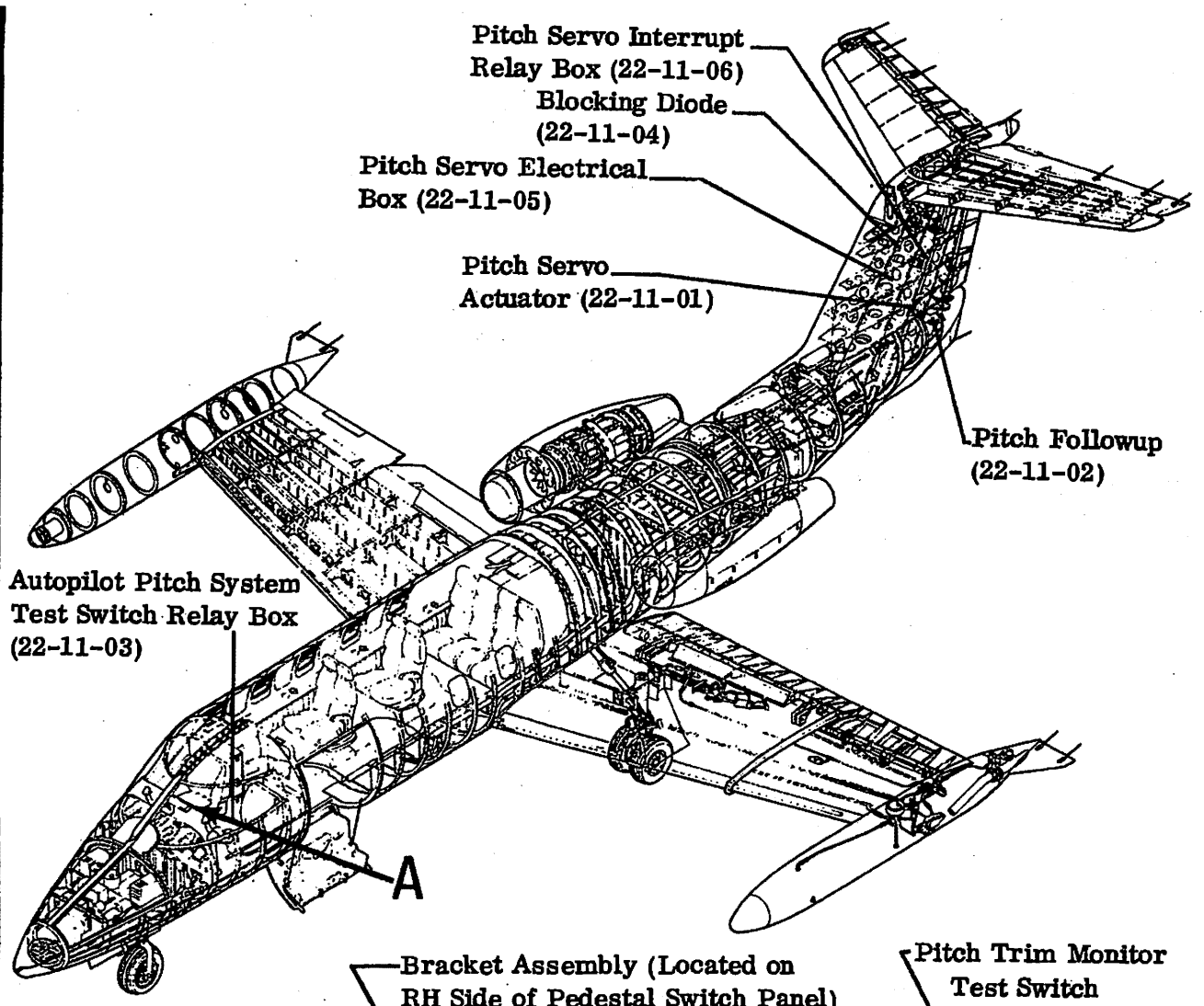
(2) Apply vacuum until copilot's altimeter indicates 18,000 feet (14.94 inches of Hg).

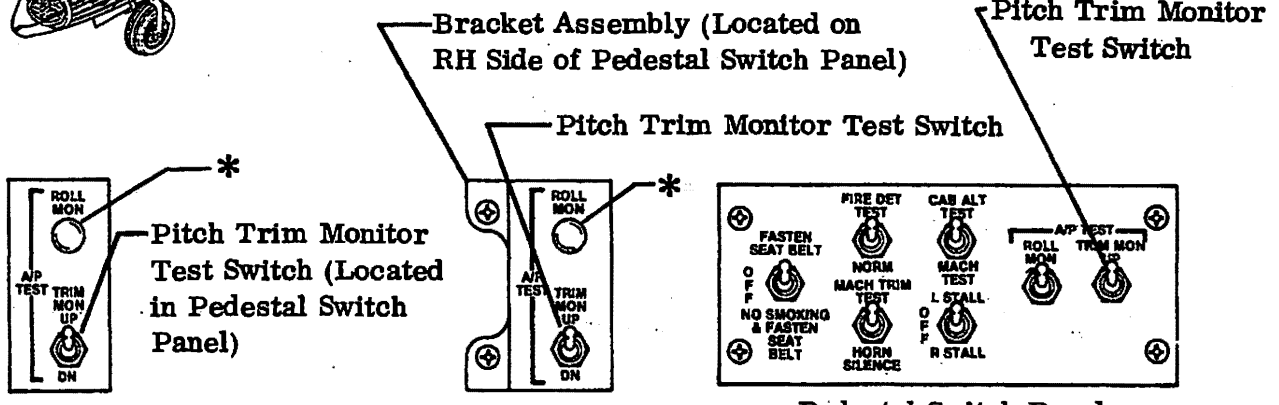
(3) Turn off vacuum source, sealing system. Altimeter indication shall not decrease more than 100 feet per minute.

(4) Slowly release vacuum and disconnect pitot-static tester from shoulder static ports and copilot's pitot and static systems.

AUTOPILOT PITCH SYSTEM - DESCRIPTION AND OPERATION

1. Description (See figure 1)
   A. The autopilot pitch system provides autopilot control of the pitch attitude of the aircraft.
   B. The autopilot pitch system consists of a pitch servo actuator, a pitch follow-up, a capstan, servo cable, an autopilot trim monitor test switch, a test switch relay box, two blocking diode assemblies, a pitch servo electrical box, and a pitch servo interrupt relay box.
   C. Component Description
      (1) The pitch servo actuator is installed in the lower portion of the vertical stabilizer. The servo is connected to the elevator control system by a cable attached at the elevator downspring yoke assembly. The servo is a direct-drive, DC torquer-type with a maximum torque output of 28 inch-pounds at the pinion.
      (2) The pitch followup is located in the lower portion of the vertical stabilizer and is mechanically connected to the aft elevator sector. The followup provides a position signal to the autopilot computer.
      (3) The capstan incorporates a cable drum, electric disconnect clutch, and mechanical slip clutch in an arrangement which couples servo actuator torque to the elevator control system. The capstan also permits the pilot to assume control of the aircraft, with autopilot engaged, by simply overpowering the autopilot system.
      (4) The autopilot trim monitor test switch is installed either in or on the RH side of the pedestal switch panel. The switch is used to check proper operation of the trim monitor circuit within the autopilot computer.
      (5) The test switch relay box is installed on the RH side of the cockpit, between stringers 11 and 12, just forward of frame 9. On Aircraft 25-061, 25-070 thru 25-330, refer to Airplane Maintenance Log for location of the test switch relay box. The relay box consists of two relays which control the signals applied to the trim monitor circuit within the autopilot computer.
      (6) The blocking diodes are installed in the upper portion of the vertical stabilizer (WL 85) just forward of spar 2.
      (7) The pitch servo electrical box is installed in the vertical stabilizer at WL 65 just forward of spar 2.
      (8) The pitch servo interrupt relay box is installed in the vertical stabilizer at WL 75 just forward of spar 3.





25-061, 25-070 Thru 25-330

Pedestal Switch Panel
25-331 and Subsequent and Prior Aircraft Modified Per AMK80-16 (Installation of Autopilot Pitch Trim Monitor Test Switch)

* Plug Button

Detail A

Autopilot Pitch System Locator
Figure 1

16-25A

AUTOPILOT PITCH SYSTEM - MAINTENANCE PRACTICES

1. Inspection/Check

A. Operational Check of Autopilot Pitch Servo

(1) Manually move control wheels to full forward and aft positions to check that no binding exists in control system.

(2) Set Battery and Inverter Switches to on.

(3) Depress Autopilot ENGAGE pushbutton.

(4) Move control column forward, then aft; control column shall slowly return to neutral from both forward and aft positions.

(5) Set Pitch Command Wheel to DN; control column shall move forward.

(6) Set Pitch Command Wheel to UP; control column shall move aft

(7) With angle of attack vanes lowered, set Stall Warning Switches to on.

(8) Slowly raise angle of attack vane until stick shaker actuates. Continue raising vane until stick shaker actuates causing control column to move forward of neutral.

(9) Lower angle of attack vane.

(10) Set Mach Test Switch to MACH TEST; aural warning unit shall sound and puller function shall move control column aft of neutral.

(11) Set all switches to OFF.

(12) Perform stick puller operational check to determine proper operation of newly installed autopilot pitch servo. (Refer to Chapter 34.)

B. Operational Check of Autopilot Pitch Trim Monitor System

(1) Connect electrical power to aircraft.

(2) Engage autopilot by depressing Autopilot ENGAGE pushbutton.

(3) Hold A/P TEST-TRIM MON Switch to UP. Autopilot pitch and roll axes shall disengage within five seconds.

(4) Release test switch and engage autopilot.

(5) Hold A/P TEST-TRIM MON Switch to DN. Autopilot pitch and roll axes shall disengage within five seconds.

AUTOPILOT PITCH SERVO ACTUATOR - MAINTENANCE PRACTICES

1. Removal/Installation

A. Remove Pitch Servo Actuator (See figure 201)

(1) Remove electrical power from aircraft.
(2) Remove vertical stabilizer access panels to gain access to elevator autopilot servo installation.
(3) Disconnect electrical connectors from capstan assembly and servo.
(4) Loosen servo cable sufficiently and unwrap cable from capstan.
(5) Remove attaching parts and capstan assembly, with servo attached, from aircraft.

B. Install Pitch Servo Actuator (See figure 201)

(1) Install pitch servo actuator and secure with attaching parts.
(2) Wrap cable on capstan. Assure that cable is wrapped the same as prior to removal.
(3) Adjust servo cable tension to 60 (±5) pounds. (Refer to Chapter 27 for cable tension temperature-load chart.)
(4) Connect electrical connectors to capstan and servo actuator.
(5) Restore electrical power to aircraft.
(6) Perform operational check of pitch servo actuator. (Refer to 22-11-00.)
(7) Install vertical stabilizer access panels.

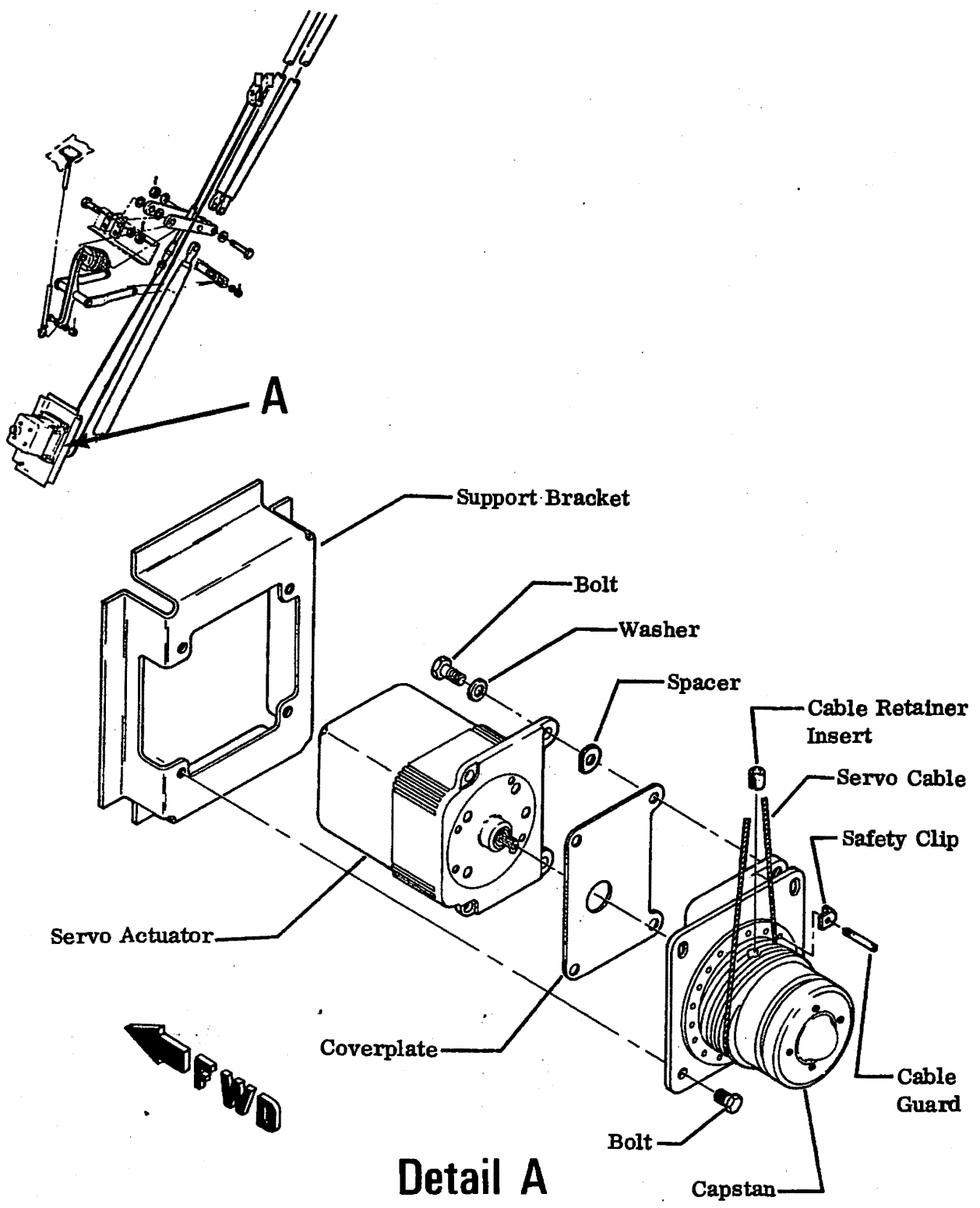
C. Remove Capstan Slip Clutch (See figure 201)

(1) Remove pitch servo actuator from aircraft.
(2) Remove attaching parts and capstan from servo actuator.

NOTE: When capstan and servo are separated, the coverplate and spacers are free. Use care not to lose spacers or damage coverplate.

D. Install Capstan Slip Clutch (See figure 201)

(1) Lightly lubricate servo pinion gear and capstan slipping gear with MIL-G-81322.
(2) Clean coverplate and apply a fresh thin coat of Mobil No. 28 grease to both sides of coverplate.
(3) Position spacers and coverplate on servo actuator.
(4) Install capstan on servo actuator. Assure that spacers are properly positioned and secure capstan to servo with attaching parts.
(5) Remove excess grease which was forced out around coverplate, allowing only a small bead of grease to remain.
(6) Install servo actuator in aircraft.



Detail A

Pitch Servo Actuator Installation
Figure 201

8-72D

2. Adjustment/Test

A. Adjust Capstan Slip Clutch (See figure 202)

(1) Remove capstan slip clutch from aircraft. Refer to paragraph 1. C.

(2) Secure capstan in a suitable mounting fixture, such as a vise.

(3) Install torque adapter (Bendix P/N 4006232-0501) on capstan where servo was installed.

(4) Install both drum guards with safety clips.

(5) Insert a pin or bolt into hole in drum surface to prevent drum from turning when pin seats against drum guards.

(6) Fabricate a wire bundle as shown in figure 202.

(7) Connect a variable DC power supply to capstan using wire bundle fabricated in step (6).

(8) Adjust DC power supply to 23. 5 vdc and close switch.

(9) Attach a torque wrench to torque adapter and check for clutch slippage of 210 to 260 inch-pounds.

NOTE: The Bendix (P/N 4006232-0501) torque adapter, when used with pitch axis capstan, has a 5. 65:1 torque ratio. With a torque value of 37 to 46 inch-pounds applied, the actual slippage torque will be 210 to 260 inch-pounds.

(10) Rotate torque wrench in opposite direction and check for clutch slippage.

(11) If torque values are not within required range, bend tab of lock-washer back and tighten or loosen check nut as required to obtain correct torque. Secure check nut by bending lockwasher tab.

(12) With 23. 5 vdc still applied to capstan, repeatedly apply torque in one direction to slip clutch. Repeat this procedure in opposite direction. No cogging shall occur below 210 inch-pounds.

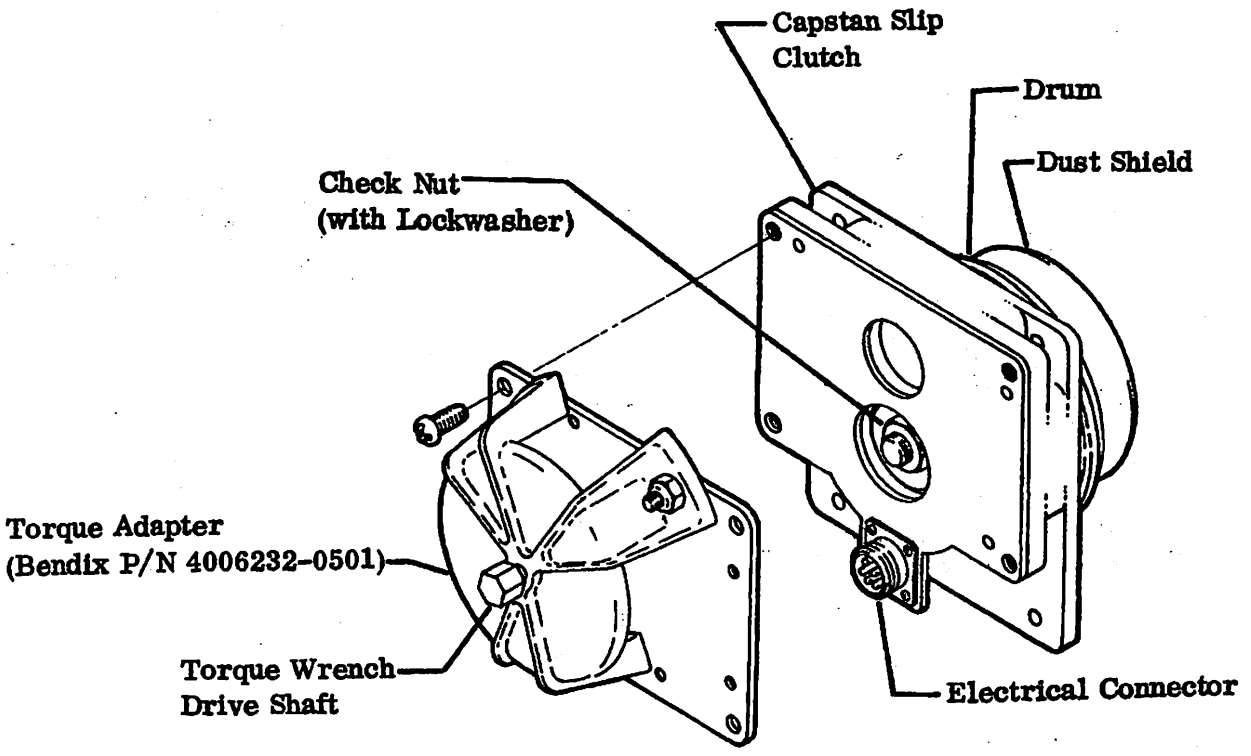
NOTE: Cogging occurs when the metal balls within the drum assembly jump from one ring seat groove to the next, causing the capstan drum to suddenly rotate approximately 15°.

(13) If cogging occurs below 210 inch-pounds while performing step (12), capstan must be replaced.

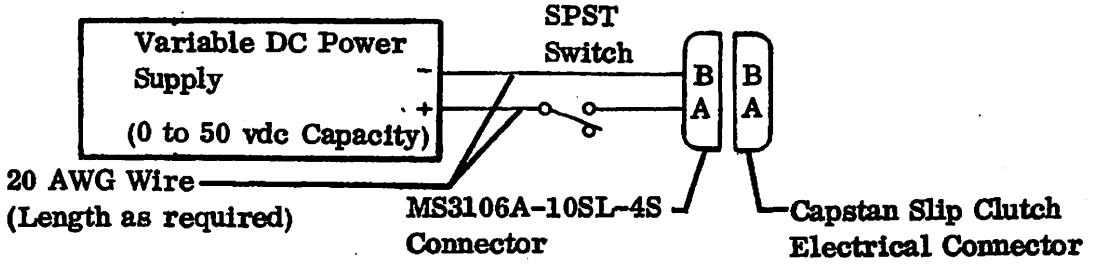
(14) Remove torque wrench and adapter from capstan assembly and disconnect DC power supply.

(15) Remove drum guards and safety clips from capstan.

(16) Install capstan slip clutch in aircraft. (Refer to paragraph 1. D.)



CAPSTAN SLIP CLUTCH AND ADAPTER ASSEMBLY



CAPSTAN SLIP CLUTCH ELECTRICAL CONNECTION

Capstan Slip Clutch Adjustment
Figure 202

PITCH FOLLOWUP - MAINTENANCE PRACTICES

1. Removal/Installation
   - A. Remove Pitch Followup (See figure 201)
     - (1) Remove electrical power from aircraft.
     - (2) Remove access covers as necessary to gain access to pitch followup.
     - (3) Disconnect electrical connector from followup.
     - (4) Loosen attaching parts securing arm to pitch followup shaft.
     - (5) Remove attaching parts and pitch followup from aircraft.
   - B. Install Pitch Followup (See figure 201)

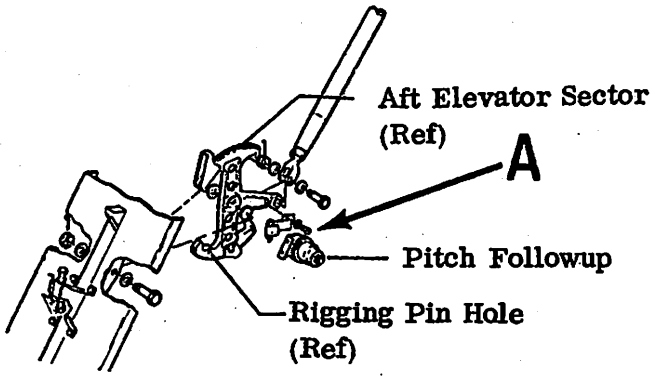
     NOTE: On aircraft equipped with pitch followup (P/N 509-1005-01) assure that red dot on housing and red dot on shaft are aligned.

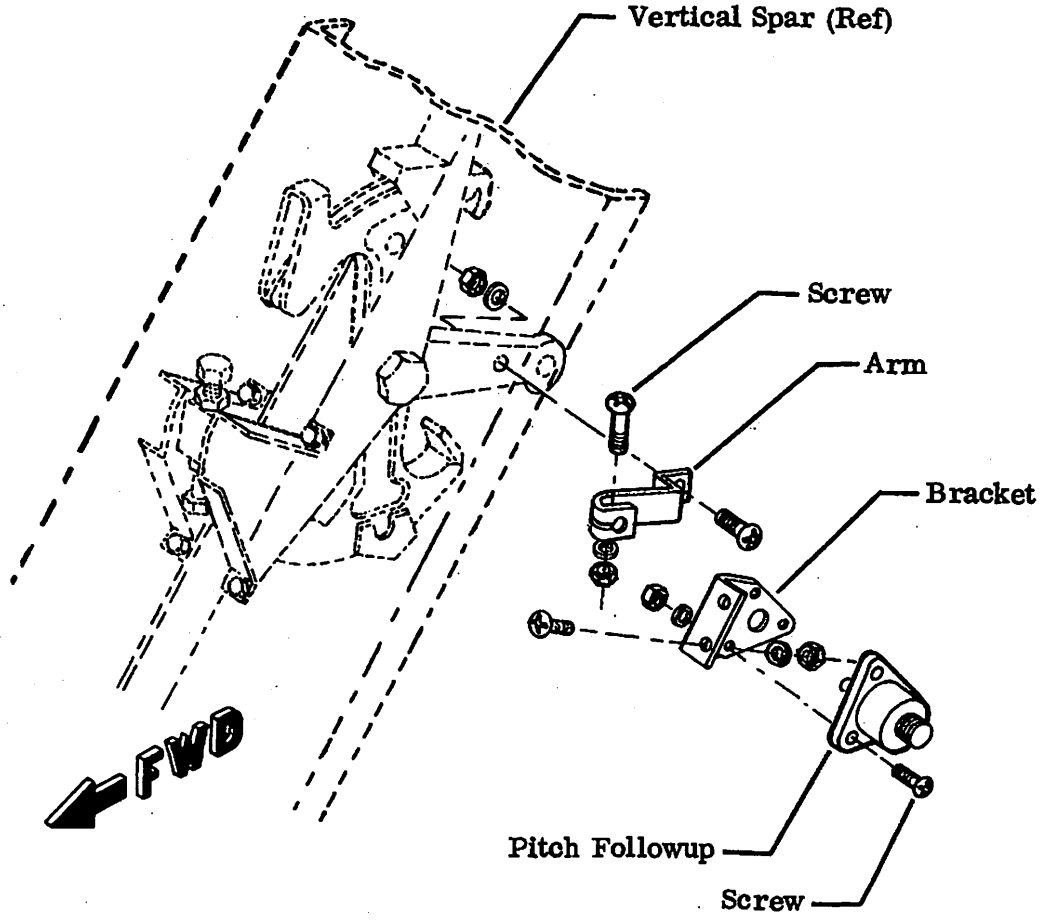
     - (1) Install pitch followup and secure with attaching parts.
     - (2) Secure arm to pitch followup shaft.
     - (3) Connect electrical connector to pitch followup.
     - (4) Perform adjustment of pitch followup.
     - (5) Install previously removed access covers.
     - (6) Restore electrical power to aircraft.

2. Adjustment/Test
   - A. Adjust Pitch Followup (See figure 202)
     - (1) Remove computer-amplifier from its rack and remove perforated lid from computer-amplifier.
     - (2) Fabricate a jumper wire approximately 2 feet long of insulated AWG 24 wire by stripping insulation from both ends.
     - (3) Remove pitch calibration module from computer-amplifier. Locate pin 14 and secure one end of jumper wire fabricated in step (2) to pin 14.
     - (4) Install pitch calibration module in the computer-amplifier and install computer-amplifier in its rack.

       NOTE: Pitch followup output is an AC signal and is measured in millivolts. Adjust sensitivity of voltmeter to read millivolts.

     - (5) Connect a voltmeter (Hewlett Packard model 3430A or Simpson type 260) to jumper wire and aircraft ground. Energize computer-amplifier by setting Battery Switches and Primary Inverter Switch to on. Remove safety wire from followup housing clamp ring screws. Loosen clamp ring screws sufficiently to allow pitch followup housing to be rotated by hand. DO NOT USE PLIERS OR WRENCH to turn pitch followup housing. Adjust followup housing until voltmeter indicates zero voltage. Only a slight adjustment should be required to zero voltmeter. On replacement of pitch followup (P/N 509-1005-1) assure that red dots are aligned with zero voltage indicated. Tighten clamp ring screws.





Detail A

Pitch Followup Installation
Figure 201

8-42D

Remove rigging pins and engage autopilot by depressing ENGAGE pushbutton on autopilot controller.

(6) With autopilot engaged, push control column forward for nose down and then release. With replacement followup (P/N 117086-01), if control column goes forward, giving a hard nose down, followup is turned 180° and step (7) must be performed. If control column returns to neutral, safety wire clamp ring screws and proceed to step (8). With replacement followup (P/N 509-1005-01), control column will return to neutral, proceed to step (8).

(7) Disengage autopilot be depressing Nose Wheel Steering pushbutton on control wheel. Insert rigging pin in elevator sectors. Loosen clamp ring screws securing followup housing to followup mounting plate. Rotate followup housing 180° by hand. DO NOT USE PLIERS OR WRENCH to turn followup housing. Null followup by adjusting followup housing until voltmeter indicates zero voltage. Tighten and safety wire clamp ring screws and remove rigging pins.

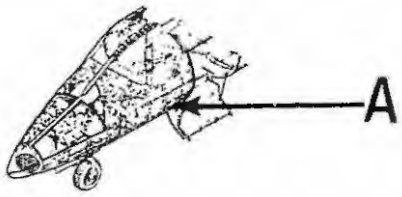
(8) Set Battery and Primary Inverter Switches to off.

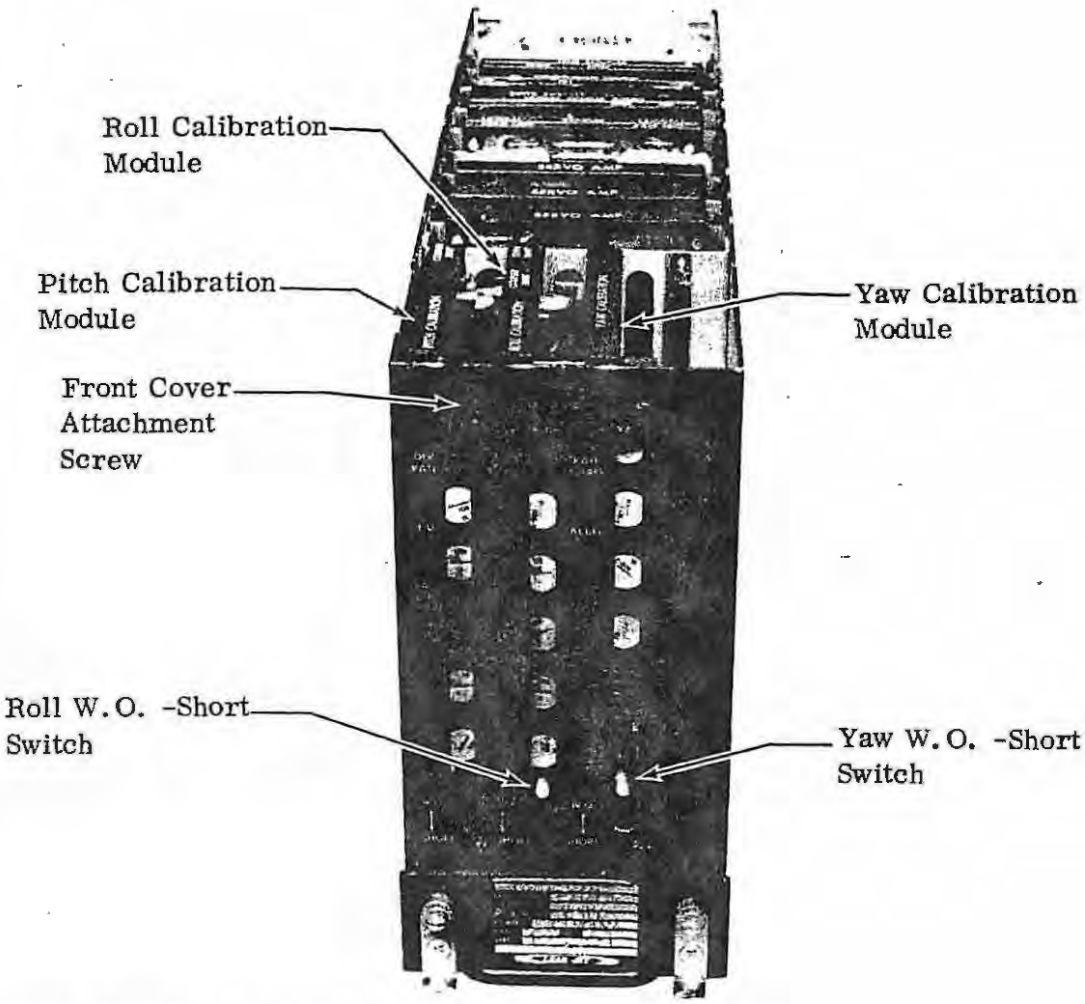
(9) Remove computer-amplifier from its rack. Remove pitch calibration module from computer-amplifier and disconnect jumper wire from pin 14.

(10) Install pitch calibration module in computer-amplifier and install computer-amplifier perforated lid.

(11) Install computer-amplifier in its rack.

(12) Install and secure all previously removed equipment.





Computer-Amplifier (Shown with front cover and porforated lid removed.)

Detail A

Pitch Followup Adjustment
Figure 202

AUTOPILOT PITCH SYSTEM TEST SWITCH RELAY BOX - MAINTENANCE PRACTICES

1. Removal/Installation

A. Remove Test Switch Relay Box (See figure 201)

NOTE: • On Aircraft 25-061, 25-070 thru 25-330, the test switch relay box is located as per AMK 80-16 (Installation of Autopilot Pitch Trim Monitor Test Switch) instructions. Refer to Aircraft Maintenance Log for location of test switch relay box.

• On Aircraft 25-331 and Subsequent, the test switch relay box is located on the RH side of the cockpit between stringers 11 and 12 just forward of frame 9.

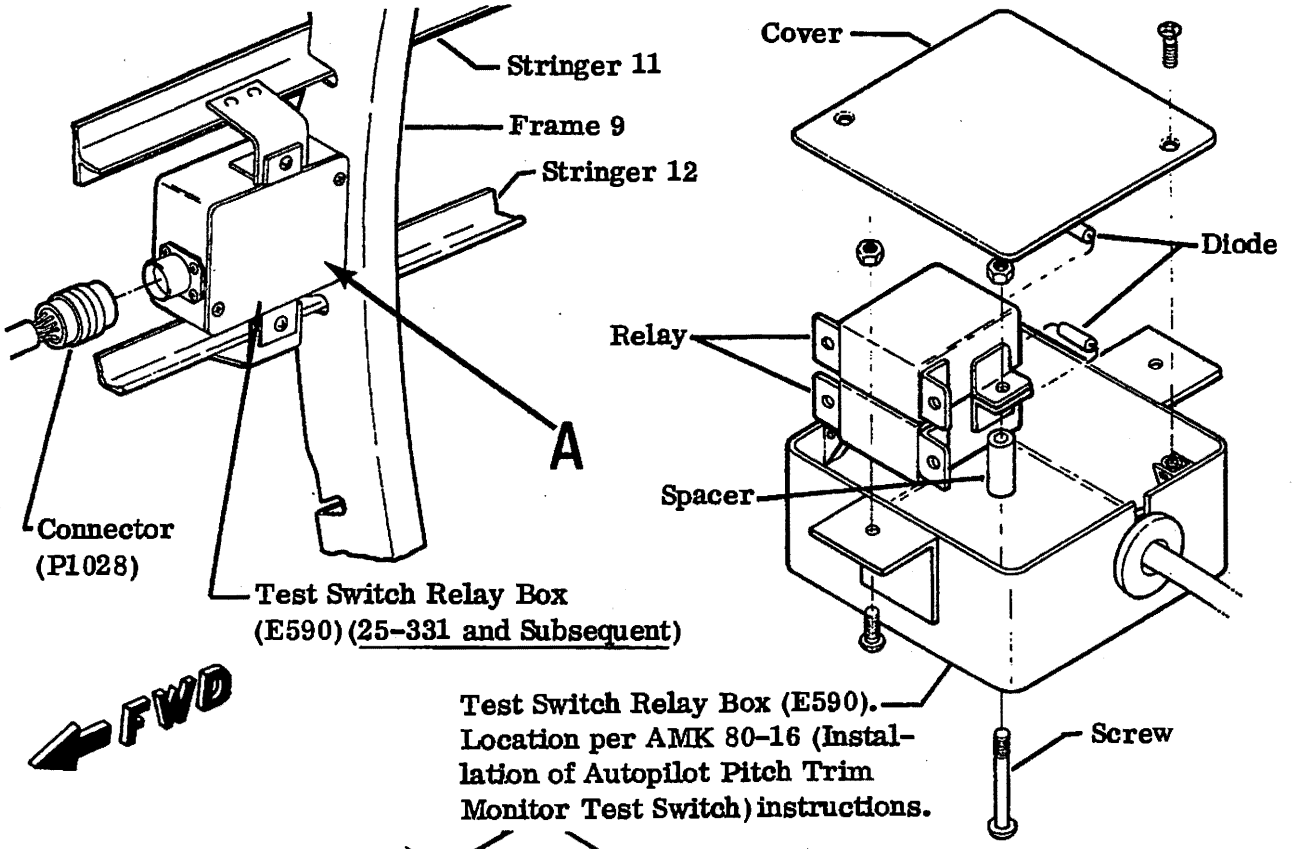
(1) Remove electrical power from aircraft.
(2) Gain access to test switch relay box installation.

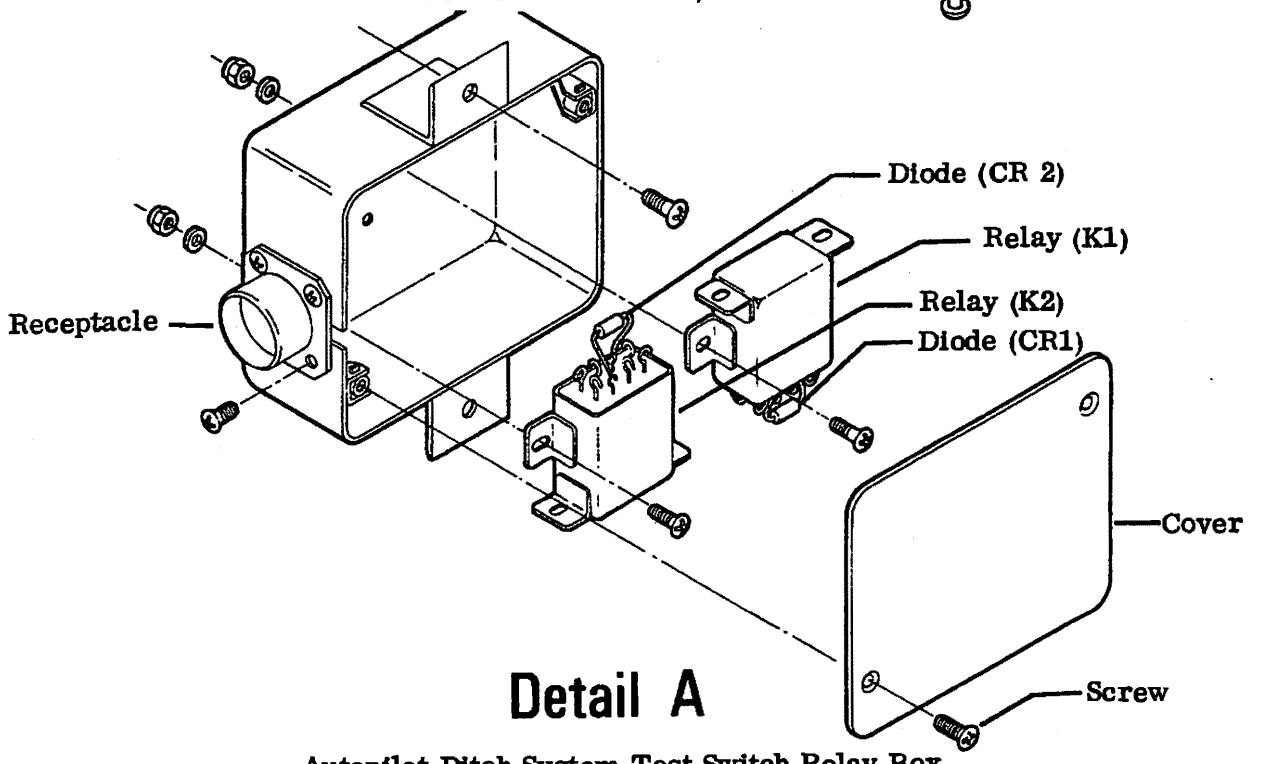
CAUTION: ASSURE THAT RELAY TERMINALS ARE IDENTIFIED WHEN WIRING IS DISCONNECTED. THIS WILL ASSURE PROPER WIRING CONNECTION WHEN TEST SWITCH RELAY BOX IS INSTALLED.

(3) Disconnect electrical wiring or electrical connector from test switch relay box.
(4) Remove attaching parts and test switch relay box from aircraft.

B. Install Test Switch Relay Box (See figure 201)

(1) Install test switch relay box and secure with attaching parts.
(2) Connect electrical wiring or electrical connector to test switch relay box.
(3) Install any previously removed equipment.
(4) Restore electrical power to the aircraft.





Detail A

Autopilot Pitch System Test Switch Relay Box
Figure 201

9-214C
9-204B

AUTOPILOT PITCH SYSTEM BLOCKING DIODE - MAINTENANCE PRACTICES

1. Removal/Installation

A. Remove Blocking Diode Assembly (See figure 201)

(1) Remove electrical power from aircraft.

(2) Remove access cover(s) from vertical stabilizer at WL 85 to gain access to blocking diodes.

(3) Disconnect electrical wiring from blocking diode assemblies at splices.

(4) Remove attaching parts and remove blocking diode assembly from aircraft.

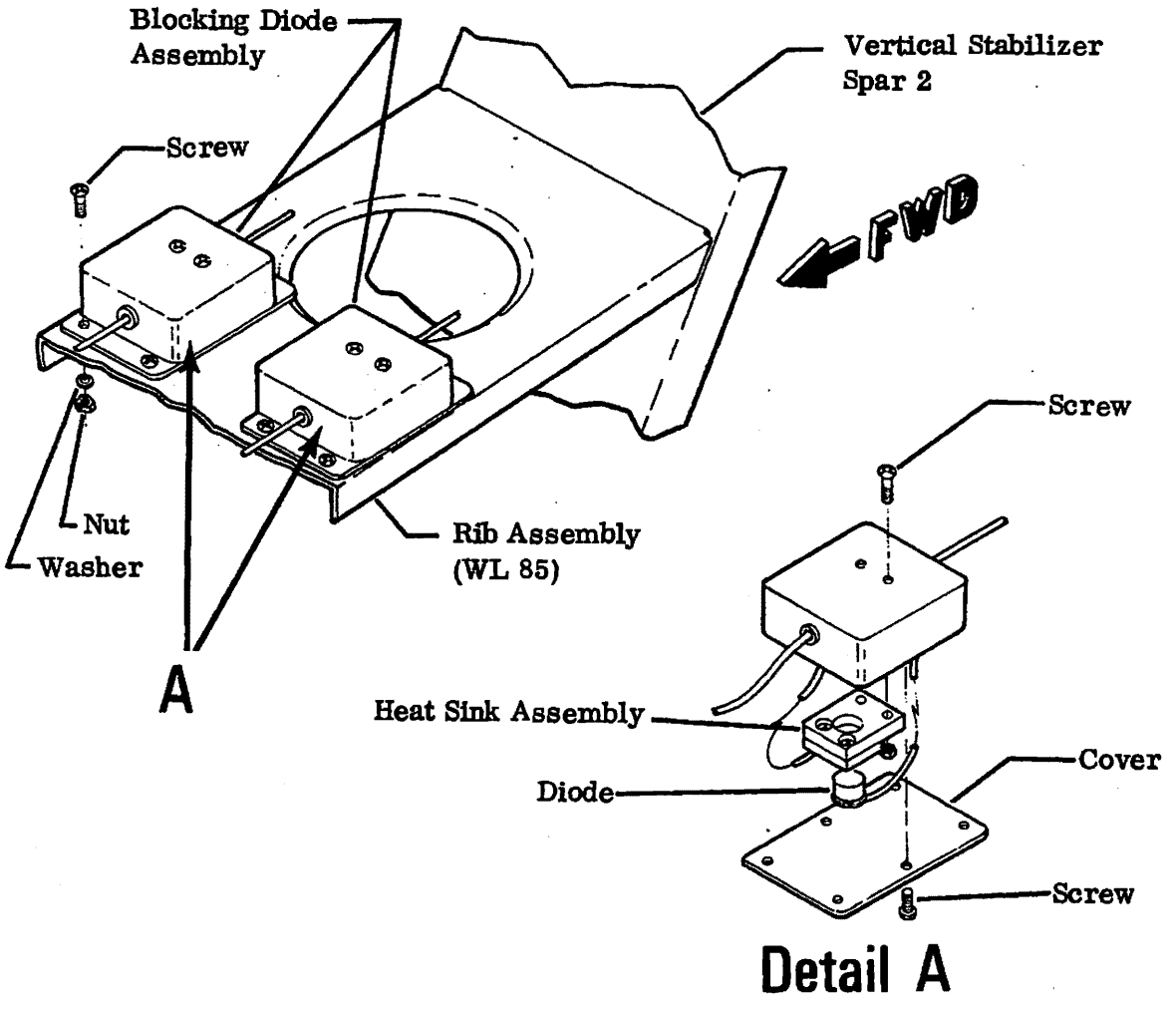
B. Install Blocking Diode Assembly (See figure 201)

(1) Install blocking diode assembly and secure with attaching parts.

(2) Connect electrical wiring to blocking diode assembly.

(3) Install and secure vertical stabilizer access cover(s).

(4) Restore electrical power to aircraft.



Autopilot Pitch System Blocking Diode Installation
Figure 201

9-205B

PITCH SERVO ELECTRICAL BOX - MAINTENANCE PRACTICES

1. Removal/Installation

A. Remove Pitch Servo Electrical Box (See figure 201)

(1) Remove electrical power from aircraft.

(2) Remove access cover from between vertical stabilizer spars 1 and 2, between WL 65 and WL 75, on LH side, to gain access to pitch servo electrical box installation.

(3) Disconnect electrical connector from pitch servo electrical box.

(4) Remove attaching parts and pitch servo electrical box from aircraft.

B. Install Pitch Servo Electrical Box (See figure 201)

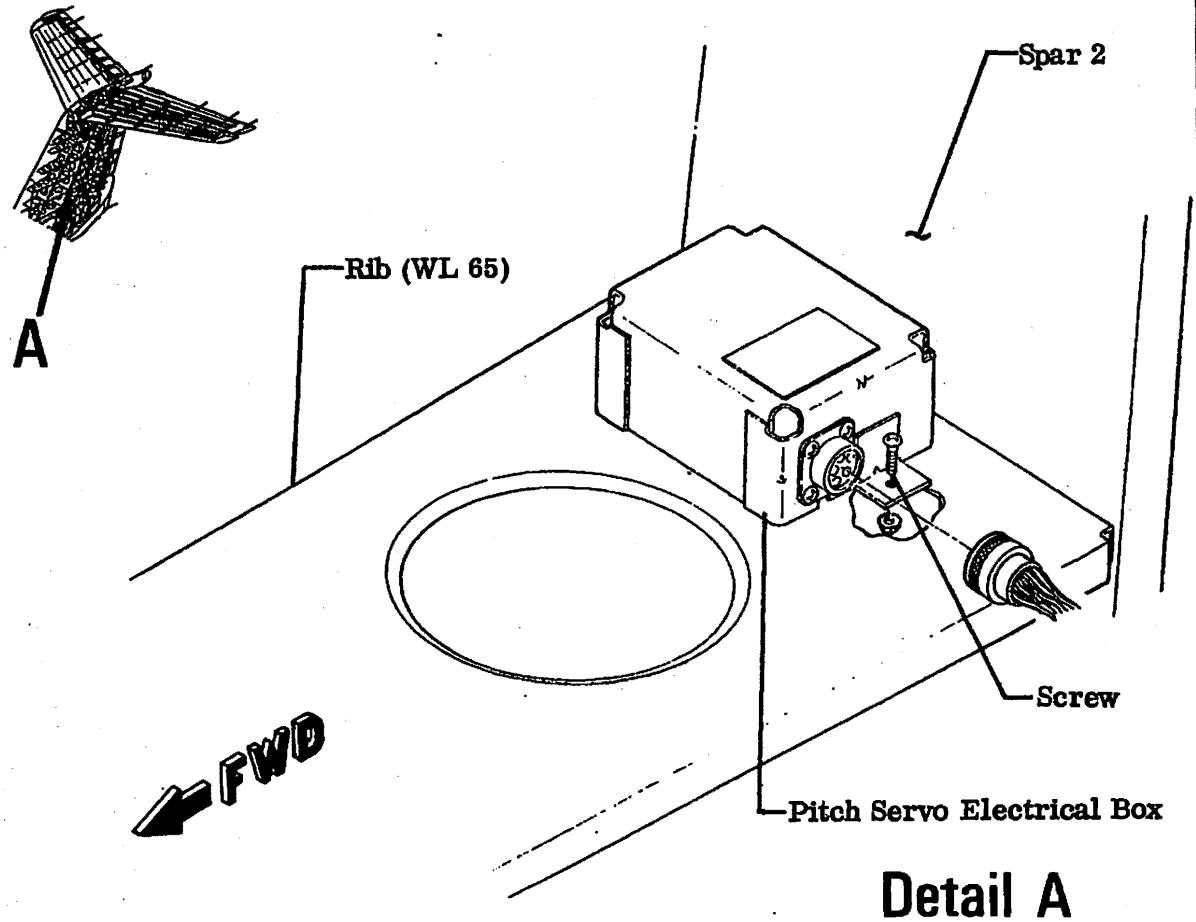
(1) Position pitch servo electrical box in vertical stabilizer and secure with attaching parts.

(2) Connect electrical connector to pitch servo electrical box.

(3) Install and secure vertical stabilizer access cover.

(4) Restore electrical power to aircraft.

(5) Perform autopilot pitch servo operational check. (Refer to 22-11-00.)



Pitch Servo Electrical Box Installation
Figure 201

PITCH SERVO INTERRUPT RELAY BOX - MAINTENANCE PRACTICES

1. Removal/Installation

A. Remove Pitch Servo Interrupt Relay Box (See figure 201)

(1) Remove electrical power from aircraft.

(2) Gain access to pitch servo interrupt relay box through vertical stabilizer access panel (LH side, between WL 75 and WL 85, and between spars 2 and 3).

(3) Disconnect electrical connector from pitch servo interrupt relay box.

(4) Remove attaching parts and pitch servo interrupt relay box from aircraft.

B. Install Pitch Servo Interrupt Relay Box (See figure 201)

(1) With electrical connector facing forward, position pitch servo interrupt relay box in vertical stabilizer and secure with attaching parts.

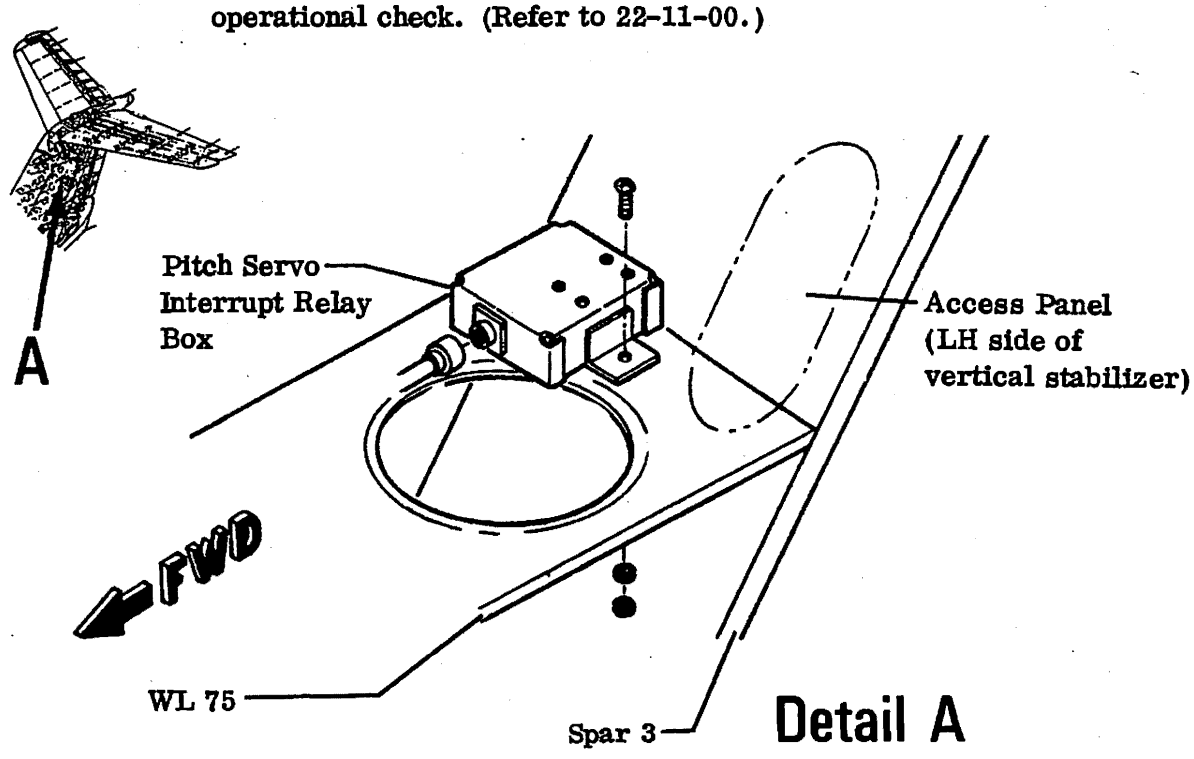
NOTE: Electrical bond relay box to aircraft structure and check electrical resistance per Chapter 20 of the Wiring Manual.

(2) Connect electrical connector to pitch servo interrupt relay box.

(3) Install and secure vertical stabilizer access panel.

(4) Restore electrical power to aircraft.

(5) Perform autopilot pitch servo and autopilot pitch trim monitor system operational check. (Refer to 22-11-00.)



9-181A-1

Pitch Servo Interrupt Relay Box Installation
Figure 201

AUTOPILOT DISENGAGE PRINTED CIRCUIT BOARD - MAINTENANCE PRACTICES

1. Removal/Installation

A. Remove autopilot disengage printed circuit board (See figure 201)

(1) Remove electrical power from aircraft.

(2) Gain access to autopilot disengage printed circuit board by removing attaching parts from perimeter of trim position indicator panel and removing panel.

(3) Disconnect electrical connector from autopilot disengage printed circuit board.

(4) Remove attaching parts and remove autopilot disengage printed circuit board.

B. Install autopilot disengage printed circuit board (See figure 201)

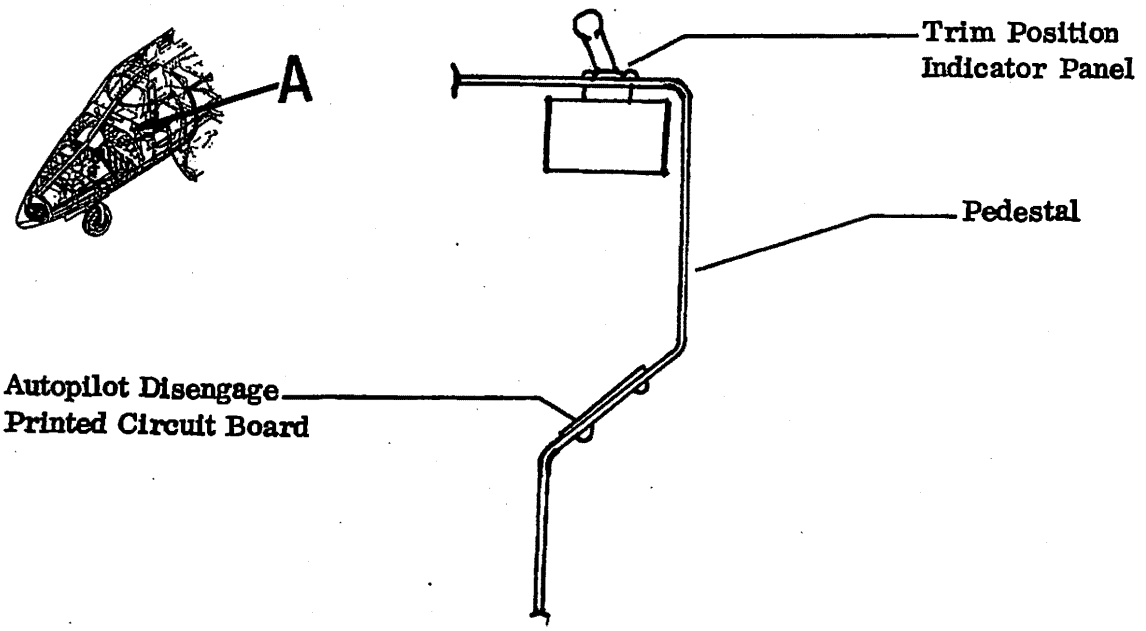
(1) Position autopilot disengage printed circuit board in trim position indicator panel and secure with attaching parts.

(2) Connect electrical connector to autopilot disengage printed circuit board.

(3) Slide trim position indicator panel into pedestal and secure with attaching parts.

(4) Restore electrical power to aircraft.

(5) Perform autopilot pitch servo and autopilot pitch trim monitor system operational checks. (Refer to 22-11-00.)



Detail A

Autopilot Disengage Printed Circuit Board Installation
Figure 201

AUTOPILOT ROLL SYSTEM - DESCRIPTION AND OPERATION

1. Description

A. The autopilot roll system provides autopilot control of the roll attitude of the aircraft.

B. The autopilot roll system consists of a roll servo actuator, roll followup, a capstan, a servo cable, an Autopilot Roll Monitor Test Switch, and a roll monitor control box.

C. Component Description

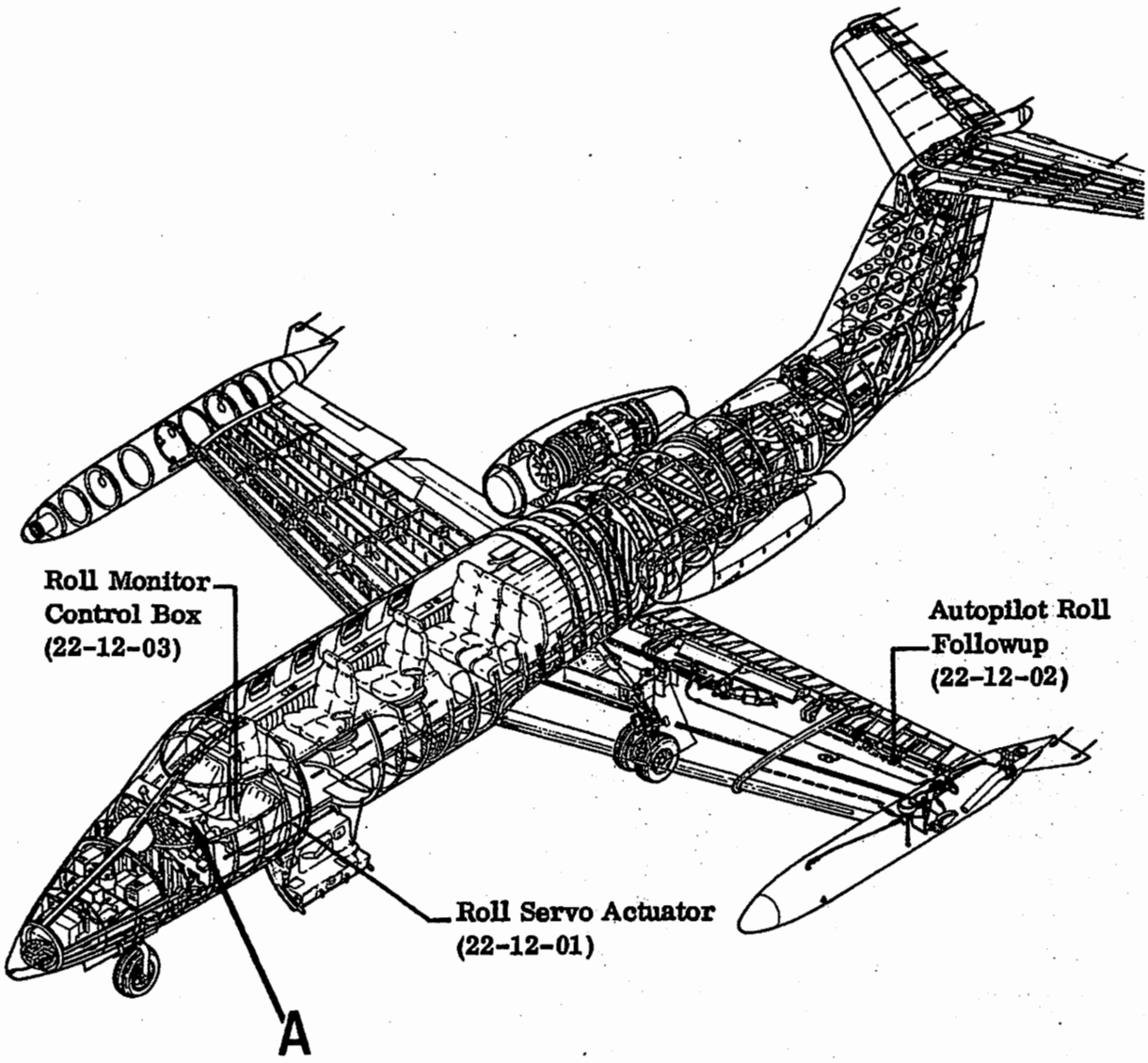
(1) The roll servo actuator is installed beneath the floorboards just forward of frame 9. The servo is connected to the aileron system cables by a servo cable. The servo is a direct drive, DC torquer-type with a maximum torque output of 28 inch-pounds at the pinion.

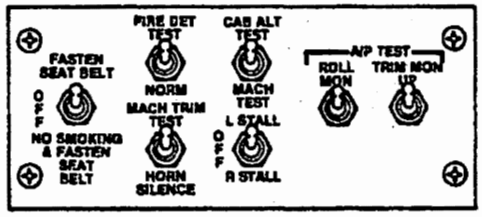
(2) The roll followup is installed in the LH wing and is mechanically connected to the aileron drive pulley assembly. The followup provides a position signal to the computer-amplifier.

(3) The capstan incorporates a cable drive drum and mechanical slip clutch in an arrangement which couples servo actuator torque to the aileron system. The capstan also permits the pilot to assume control of the aircraft, with autopilot engaged, by simply overpowering the autopilot system. The slip clutch is set to slip at 150 to 165 inch-pounds.

(4) The Autopilot Roll Monitor Test Switch is located on the pedestal switch panel or on a bracket assembly located on the RH side of the pedestal switch panel. The switch is used to check proper operation of the roll monitor circuit within the autopilot computer.

(5) On Aircraft 25-337, 25-342 and Subsequent, the roll monitor control box is installed on the floorboards beneath the copilot's seat. On Prior Aircraft Modified per AMK 81-7 or AMK 81-9 (Horizontal Stabilizer Trim and Autopilot Improvement), the roll monitor control box is installed beneath the divan at centerline of the aircraft just forward of frame 17A.





Pedestal Switch Panel
(Typical Installation)

Detail A

Autopilot Roll System Locator
Figure 1

16-25A

AUTOPILOT ROLL SERVO ACTUATOR - MAINTENANCE PRACTICES

1. Removal/Installation

A. Remove Roll Servo Actuator (See figure 201.)

NOTE: • On aircraft with pedestal extending aft to approximate cabin frame 8, remove one crew seat and screws attaching pedestal to aircraft floor. Move pedestal to area of removed seat.
• On aircraft with long pedestal which extends past front edge of cabinets, it will be necessary to remove pedestal.

A. Remove Roll Servo Actuator (See figure 201.)
(1) Remove electrical power from aircraft.
(2) Remove carpet and floorboards as required to gain access to roll servo actuator.
(3) Disconnect electrical connector from roll servo actuator.
(4) Remove attaching parts and roll servo actuator from aircraft.
(5) Cover holes in mounting bracket with tape. This will prevent foreign matter from entering capstan slip clutch gear.

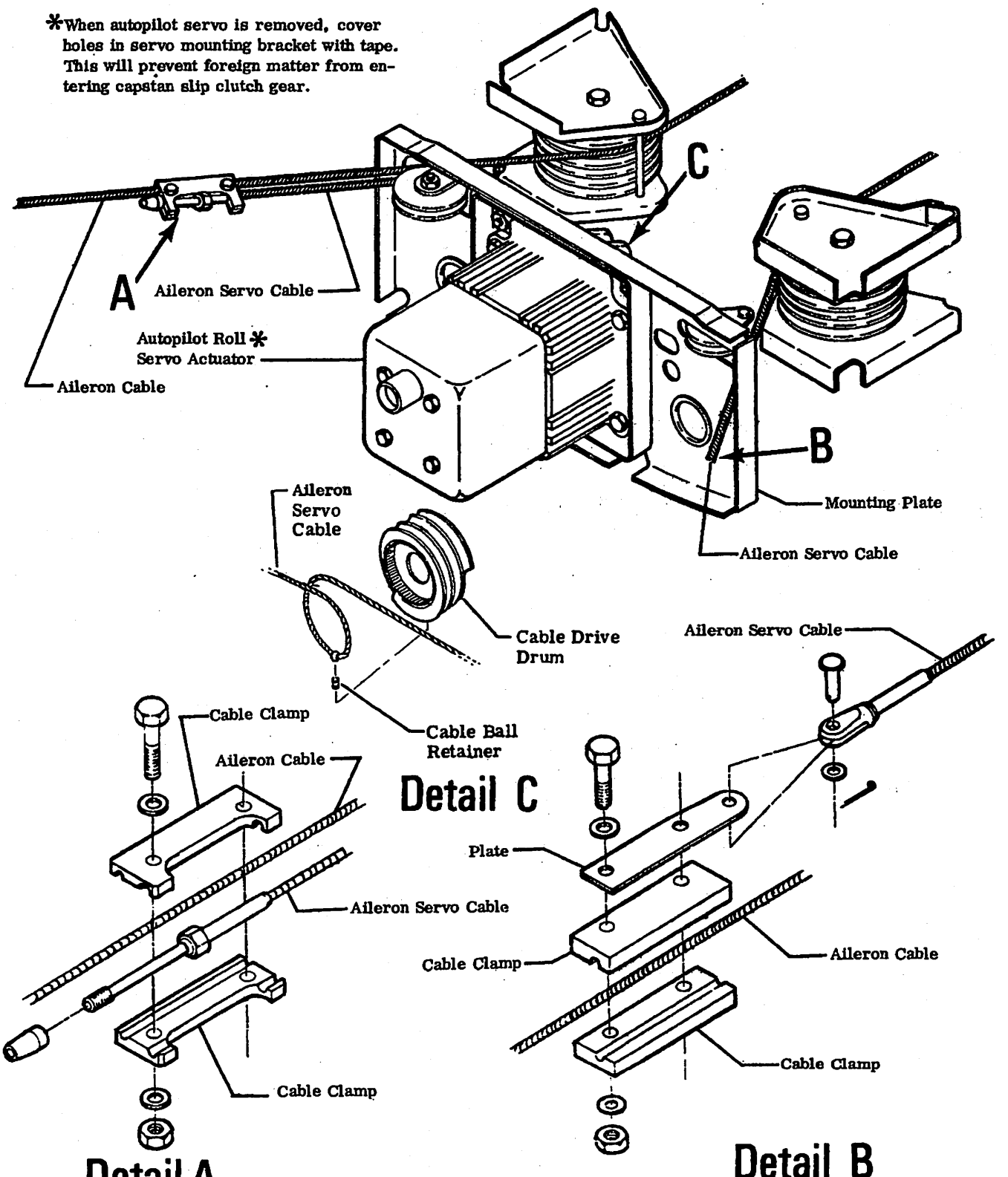
B. Install Roll Servo Actuator (See figure 201.)
(1) Remove tape from mounting bracket holes.
(2) Lightly lubricate roll servo actuator pinion gear and slip clutch ring gear with MIL-G-81322 grease.
(3) Install roll servo actuator and secure with attaching parts.
(4) Connect electrical connector to roll servo actuator.
(5) Install floorboards and carpet.
(6) Restore electrical power to aircraft.

C. Remove Capstan Slip Clutch (See figure 201.)
(1) Remove electrical power from aircraft.
(2) Remove carpet and floorboards to gain access to capstan slip clutch.
(3) Disconnect electrical connector from roll servo actuator.
(4) Remove attaching parts and roll servo actuator from mounting plate.
(5) Remove attaching parts and shroud from capstan.
(6) Loosen servo cable turnbuckle and unwrap cable from capstan.
(7) Slip cable drum assembly from mounting plate stud.

NOTE: Wiper disc, spring, and retainer ring will remain secured to mounting plate. Remove only if replacement is necessary.

D. Install Capstan Slip Clutch (See figure 202.)
(1) Clean and relubricate the mounting plate center stud with MIL-G-81322 grease.
(2) Install cable drum assembly on mounting plate center stud.
(3) Wrap servo cable around capstan, assuring that servo cable is wrapped as shown.
(4) Adjust servo cable tension to 25 (±5) pounds. (Refer to Chapter 27 for cable tension temperature-load correction chart.)

*When autopilot servo is removed, cover holes in servo mounting bracket with tape. This will prevent foreign matter from entering capstan slip clutch gear.



Roll Servo Actuator Installation
Figure 201

8-71C

2. Adjustment/Test

A. Adjust Capstan Slip Clutch (See figure 202)

(1) Remove capstan slip clutch. (Refer to paragraph 1. C.)

(2) Place adapter block in vise. Position cable drum assembly in torque adapter block and secure with adapter pin.

(3) Attach a torque wrench to adapter gear and place adapter gear into cable drum assembly.

(4) After initial clutch breaking force occurs, move torque wrench left and right through entire clutch travel range.

(5) Clutch slippage should occur at 150 to 165 inch-pounds.

(6) Adjust clutch by loosening or tightening lockmut. Tighten lockmut to increase clutch torque; loosen lockmut to decrease clutch torque.

NOTE: If the correct clutch torque settings cannot be obtained, disassemble the drum assembly, clean and relubricate the internal surface (both sides) of drum with a light application of Dow Corning No. 33 grease. Reassemble drum assembly and adjust slip clutch by repeating steps (2) through (6).

(7) Install capstan slip clutch. (Refer to paragraph 1. D.)

3. Inspection/Check

A. Check Capstan Slip Clutch (See figure 202)

(1) Remove roll servo actuator. (Refer to paragraph 1. A.)

(2) Disconnect electrical connector from roll servo actuator and remove roll servo from aircraft.

(3) Bolt torque adapter to mounting plate, assuring that torque adapter gear is properly mated to cable drum assembly.

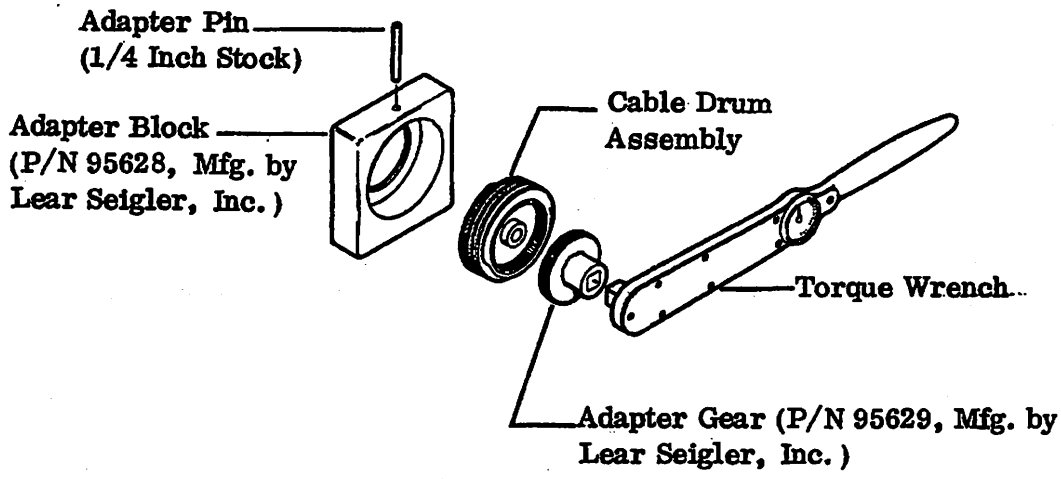
NOTE: The Bendix (P/N 4006232-0501) torque adapter, when used with roll axis capstan, has a 5.0:1 torque ratio. With a torque value of 30 to 33 inch-pounds applied, the actual slippage torque will be 150 to 165 inch-pounds.

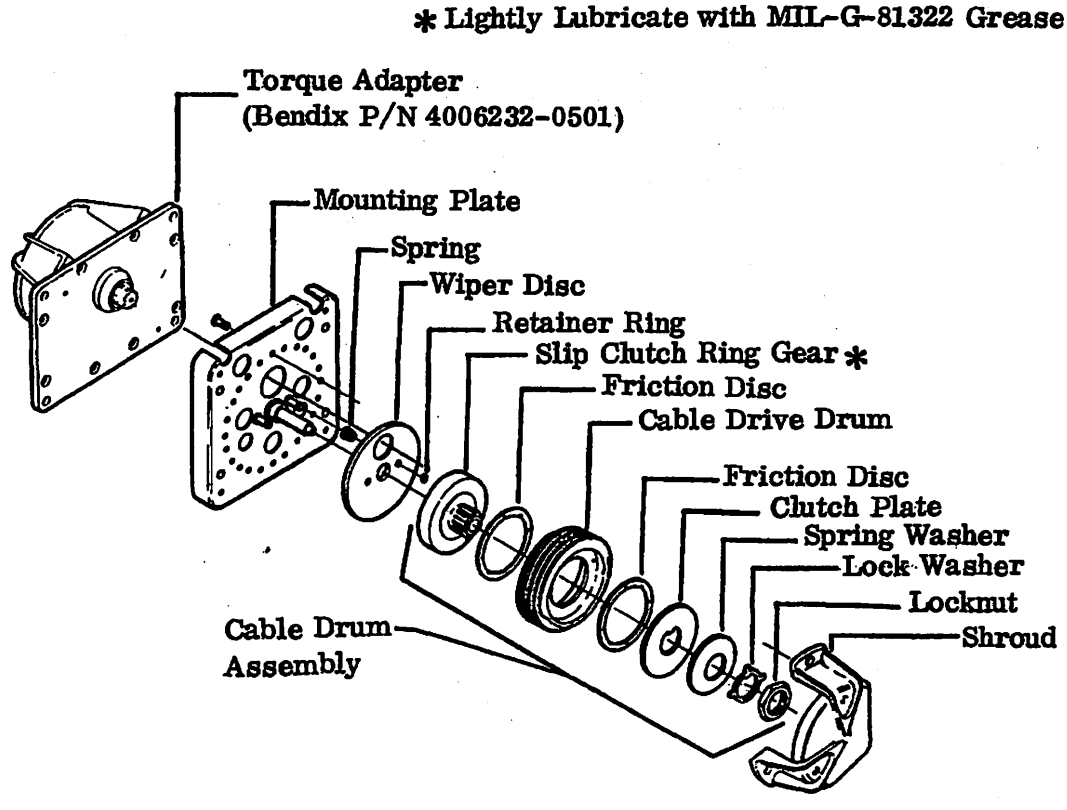
(4) Attach a torque wrench to torque adapter and check for proper clutch slippage.

(5) Hold torque wrench against one side of floorboard structure so that wrench does not move. Move control wheel fully to left and right several times until clutch slippage is reasonably smooth.

(6) If clutch setting is not within tolerance, refer to paragraph 2. A.

(7) Install roll servo actuator. (Refer to paragraph 1. B.)





8-40C

Capstan Slip Clutch Adjustment
Figure 202

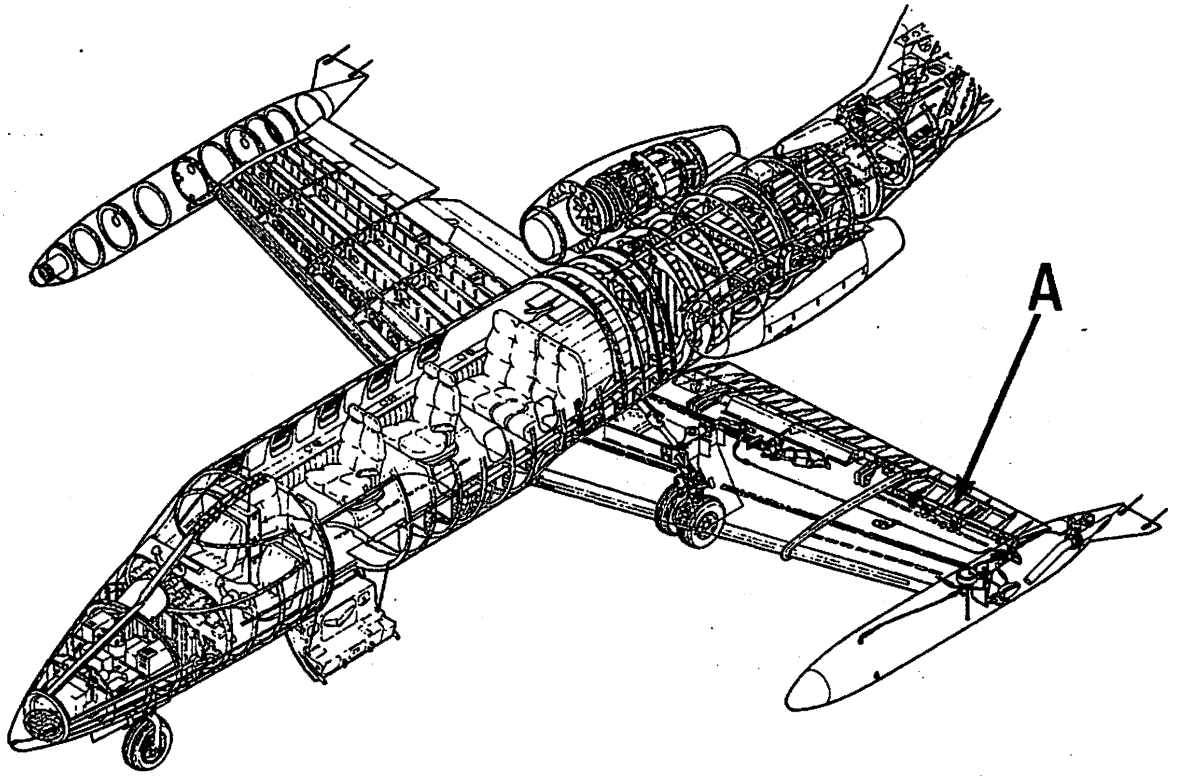
AUTOPILOT ROLL FOLLOWUP - MAINTENANCE PRACTICES

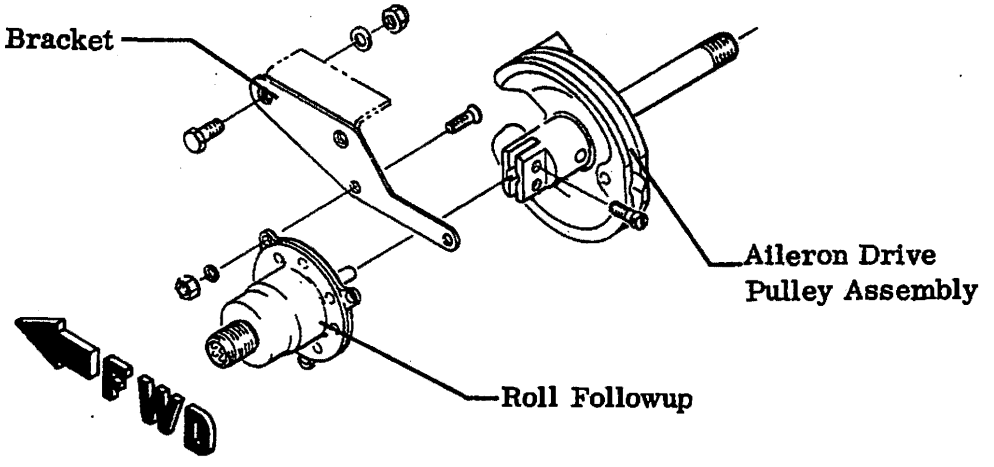
1. Removal/Installation
   - A. Remove Roll Followup (See figure 201)
     - (1) Remove electrical power from aircraft.
     - (2) Assure that aileron system is properly rigged and insert rigging pin in Copilot's Control Wheel.
     - (3) Remove access panel from lower wing to gain access to roll followup installation.
     - (4) Disconnect electrical connector from roll followup.
     - (5) Remove safety wire and loosen screws securing followup shaft to aileron pulley drive shaft.
     - (6) Loosen and remove attaching parts and roll followup from aircraft.
   - B. Install Roll Followup (See figure 201)
     - (1) Align null dots on roll followup.
     - (2) Carefully install followup by inserting roll followup on mounting bracket.
     - (3) Secure roll followup to bracket with attaching parts.
     - (4) Connect electrical connector to roll followup.
     - (5) Adjust roll followup. (Refer to paragraph 2.A.)
     - (6) Restore electrical power to aircraft.

2. Adjustment/Test
   - A. Autopilot Roll Followup Adjustment (See figure 202)

CAUTION: ON AIRCRAFT 25-061, 25-070 THRU 25-096, CHECK PART NUMBER ON REPLACEMENT ROLL FOLLOWUP. IF PART NUMBER IS 509-1005-01, THE WIRES CONNECTED TO PIN C AND D ON THE ROLL FOLLOWUP ELECTRICAL CONNECTOR MUST BE REVERSED IN ORDER FOR THE NULL DOTS ON THE FOLLOWUP TO ALIGN. OTHERWISE THE NULL DOTS MUST BE 180° APART FOR THE NULL TO BE COMPATIBLE WITH THE AIRCRAFT ELECTRICAL SYSTEM WIRING. ON AIRCRAFT 25-097 AND SUBSEQUENT, TO BE COMPATIBLE WITH AIRCRAFT ELECTRICAL WIRING THE NULL DOTS MUST BE ALIGNED.

- (1) For replacement roll followup (P/N 117086-01), connect electrical connector and install roll followup arm on followup shaft. On Aircraft 25-061, 25-070 thru 25-096, align red dots 180° apart. If roll followup electrical connector wires are reversed, align red dots. Connect electrical connector and install roll followup arm on roll followup shaft. On Aircraft 25-097 and Subsequent, red dots must be aligned.
- (2) Remove computer-amplifier from its rack and remove perforated lid from computer-amplifier.





Detail A

8-10C

Autopilot Roll Followup Installation
Figure 201

(3) Fabricate a jumper wire approximately 2 feet long of insulated AWG 24 wire by stripping insulation from both ends.

(4) Remove roll calibration module from computer-amplifier, locate pin 11, and secure one end of jumper wire fabricated in step (3) to pin 11.

(5) Install roll calibration module in computer-amplifier and install computer-amplifier in its rack.

(6) Remove computer-amplifier front cover and set ROLL, W.O.-SHORT Switch to SHORT.

NOTE: Followup output is an AC signal and is measured in millivolts. Adjust sensitivity of voltmeter to read millivolts.

(7) Connect a voltmeter (Hewlett Packard Model 3430A or Simpson type 260 or equivalent) to jumper wire and aircraft ground. Set Battery Switches on and Inverter Switch to PRI. Loosen roll followup arm on roll followup shaft and adjust shaft until voltmeter indicates zero voltage. Only a slight adjustment should be required to zero voltmeter. It should be noted that, due to inherent resistance in the roll followup system, the red dots may not be exactly aligned when an electrical null is established. Tighten roll followup arm on roll followup shaft. Remove rigging pin and engage autopilot by depressing ENGAGE pushbutton on autopilot controller.

(8) With autopilot engaged, turn control wheel for a left wing down and then release. With replacement roll followup (P/N 117086-01), if Control Wheel goes hard over, roll followup is turned 180° and step (9) must be performed. If control wheel returns to center, proceed to step (10). With replacement roll followup (P/N 509-1005-01), control wheel will return to center. Proceed to step (10).

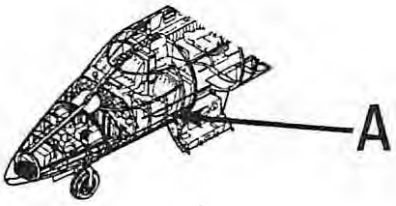
(9) Disengage autopilot by depressing Nose Wheel Steering pushbutton on control wheel. Insert rigging pin into copilot's control wheel. Loosen roll followup arm from roll followup shaft and rotate shaft 180°. Null roll followup by adjusting shaft until voltmeter indicates zero voltage. Tighten roll followup arm on roll followup shaft. Remove rigging pin.

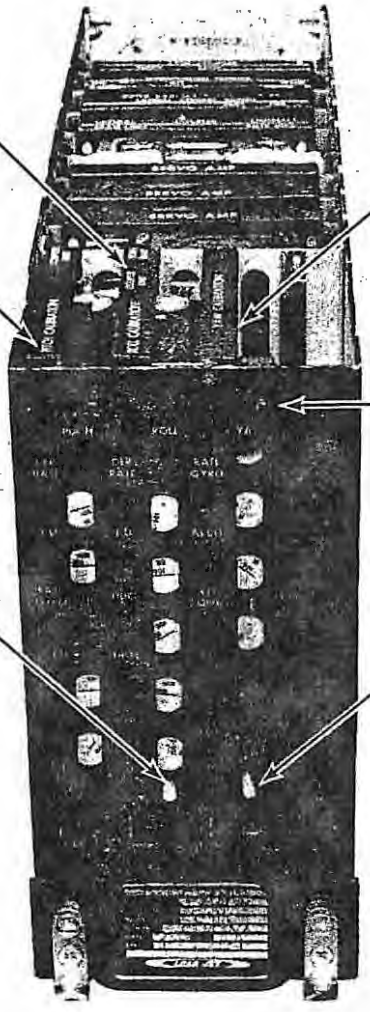
(10) Set ROLL, W.O.-SHORT Switch on computer-amplifier to W.O. and Battery, Inverter, and Autopilot Disconnect Switches off. Remove roll calibration module from computer-amplifier and disconnect jumper wire from pin 11.

(11) Install roll calibration module in computer-amplifier and install perforated lid and front cover on computer-amplifier.

(12) Install computer-amplifier in its rack.

(13) Install and secure all previously removed equipment.





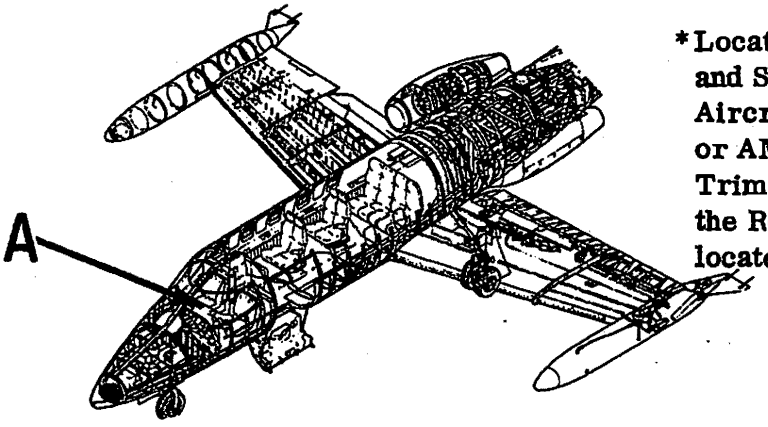
Computer-Amplifier
(Shown with front cover
and perforated lid removed)

Detail A

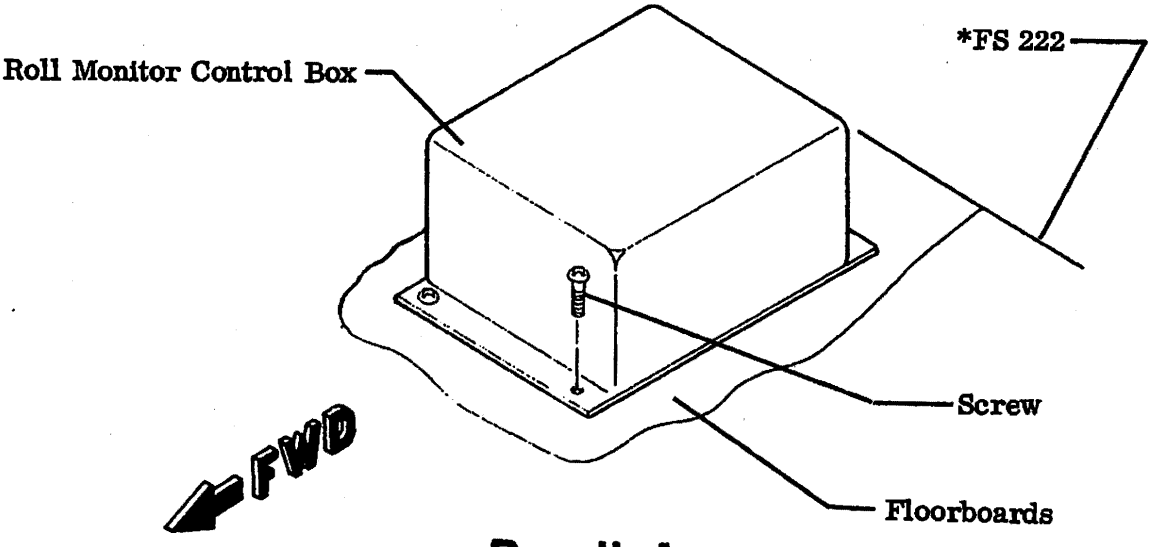
Autopilot Roll Followup Calibration and Adjustment
Figure 202

AUTOPILOT ROLL MONITOR CONTROL BOX - MAINTENANCE PRACTICES

1. Removal/Installation
   - A. Remove Autopilot Roll Monitor Control Box (See figure 201)
     - (1) Remove electrical power from aircraft.
     - (2) Gain access to roll monitor control box installation.
     - (3) Disconnect electrical connector from roll monitor control box.
     - (4) Remove attaching parts and roll monitor control box from aircraft.
   - B. Install Autopilot Roll Monitor
     - (1) Install roll monitor control box and secure with attaching parts.
     - (2) Connect electrical connector to roll monitor control box.
     - (3) Restore electrical power to aircraft.



*Location Eff. 25-337, 25-342 and Subsequent. On Prior Aircraft Modified per AMK 81-7 or AMK 81-9 (Horizontal Stabilizer Trim and Autopilot Improvement) the Roll Monitor Control Box is located forward of frame 17A.



Detail A

9-180A

Autopilot Roll Monitor Control Box Installation
Figure 201

MACH TRIM SYSTEM - DESCRIPTION AND OPERATION

1. Description
   A. The mach trim system is an integral part of the autopilot and consists of a mach trim switch (refer to Chapter 34) in the pitot-static system that is electrically connected to the aural warning system, a test switch, a force sensor, and automatic trim and mode disconnects.
   B. The mach trim switch is calibrated to provide an aural warning when a speed of 0.78 M is reached if the autopilot is not engaged. Reducing speed or engaging autopilot will silence the warning.
   C. A force sensor in the elevator system applies a signal to an amplifier-switch circuit which is calibrated to provide autopilot trim and mode disengage when the pilot overpowers the autopilot with a force in excess of 8 (±1) pounds.
   D. The altitude hold and wings level (roll) modes are not disengaged when the autopilot is overridden. This allows the aircraft to return to the altitude and wing attitude and aircraft heading existing prior to altitude overpower.

2. Operation
   A. The autopilot pitch axis provides an attitude hold function. The pitch axis is synchronized to the aircraft attitude at the time of engagement and holds the aircraft in this attitude. The attitude may be manually changed by the Pitch Command Wheel on the autopilot controller. Attitude may also be changed by the Pitch Sync Switch or Maneuver Control Switches; however, these methods will cause warnings to occur if aircraft speed is greater than 0.78 M.
   B. The monitor circuit is contained within the autopilot computer-amplifier. The transistor circuit receives two signal inputs: a ground from the mach trim switch when a speed of 0.78 M is exceeded and, 28 vdc from the Pitch Sync Switch power. Application of Pitch Sync power switches a transistor in the circuit, locking the output transistor in an off state which prevents occurrence of a warning. When the mach trim switch actuates, a ground is applied to another transistor in the circuit and it is switched from a normal on state to an off state. If the output transistor has not been "locked out" by the Pitch Sync power, the transistor switches on and the overspeed warning occurs. Pitch Sync power is removed from the monitor circuit and autopilot (1) whenever power is not applied to the Pitch Sync circuit of the autopilot (autopilot not engaged), (2) whenever attitude of the airplane is changed by the Pitch Sync Switch or Maneuver Control Switches or (3) whenever the stall warning or mach warning system commands an attitude change with the pusher or puller.
   C. The force sensor, installed in the elevator control system, provides a signal with amplitude phase proportional to the amount and direction of overpower force of the autopilot by the pilot. If the pilot overpowers the autopilot with a force in excess of 8 (±1) pounds, the solid state switching circuits disengage the autopilot trim in the pitch and roll axis. In the pitch axis, the autopilot trim and altitude hold are disengaged. In the roll axis, all lateral

modes, except roll stabilization, wings-level attitude are disengaged. This allows the pilot to perform abrupt maneuvers without increased autopilot trim forces and to automatically regain a wings-level attitude.

3. Inspection/Check

A. Mach Trim Operational Check

(1) Set Battery and Primary Inverter Switches to on.

(2) Depress WRN LTS, PRI AFCS, AFCS ROLL, YAW, and PITCH circuit breakers.

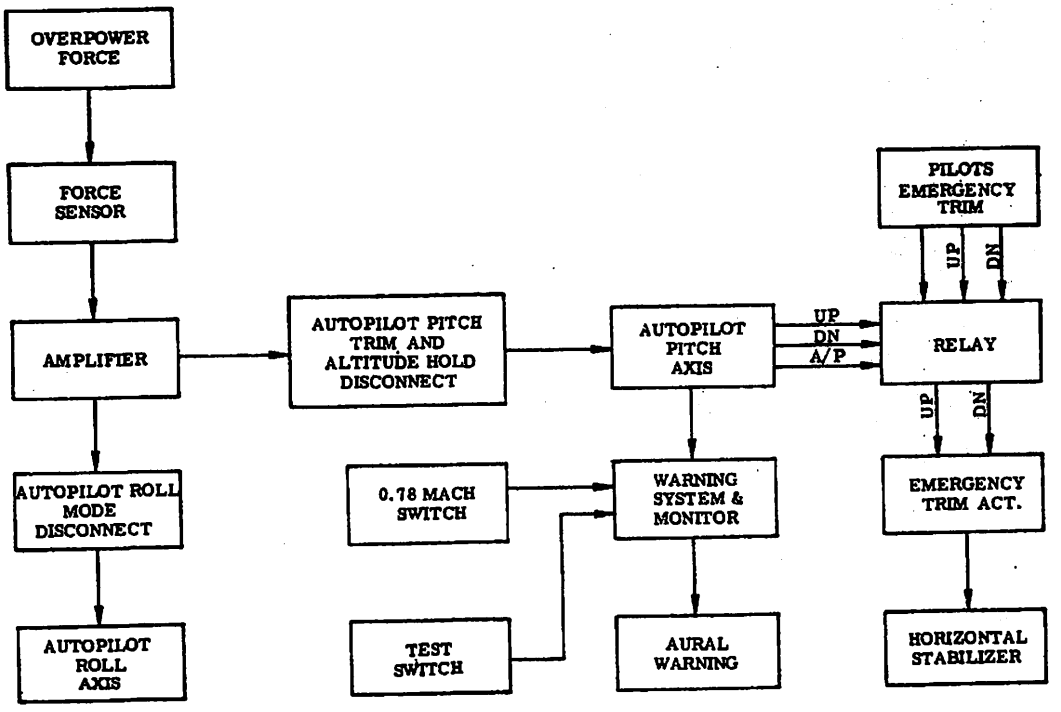
(3) Hold AFC/SS Test Switch to TEST position; aural warning shall sound. Release switch.

(4) Depress AFCS ENGAGE, HDG, and ALT pushbuttons.

(5) Hold AFC/SS Test Switch to TEST position; no aural warning shall sound. Release switch.

(6) Pull control column hard aft; HDG and ALT pushbuttons shall return to off position.

(7) Depress Autopilot Disconnect pushbutton on control wheel to disengage autopilot system.



Mach Trim System Block Diagram
Figure 1

FORCE SENSOR - MAINTENANCE PRACTICES

1. Removal/Installation

A. Remove Force Sensor (See figure 201)

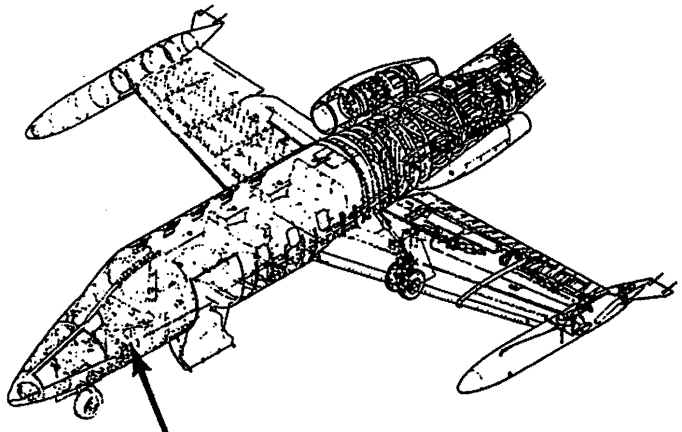
(1) Gain access to force sensor by removing floorboards.

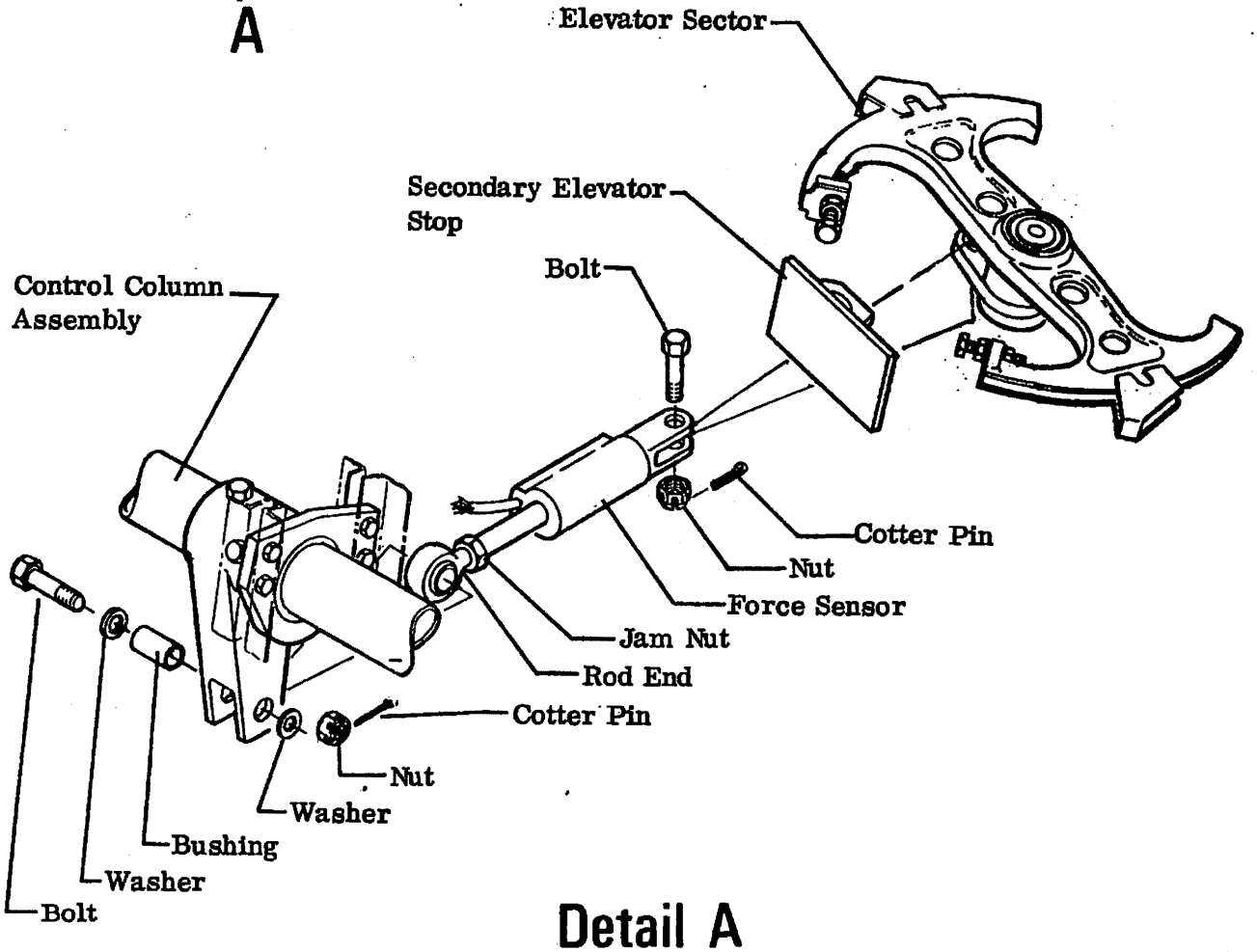
NOTE: The force sensor is located at the centerline of the aircraft. One end of the force sensor is connected to the control column with the other end connected to the elevator sector at FS 204.

(2) Remove electrical power from aircraft.
(3) Place elevator in neutral position.
(4) Disconnect force sensor electrical connector.
(5) Remove parts which attach force sensor to control column.
(6) Remove parts which attach force sensor to elevator sector and remove force sensor from aircraft.

B. Install Force Sensor (See figure 201)

(1) Place elevator in neutral position.
(2) Secure force sensor to elevator sector with attaching parts.
(3) Position other end of force sensor in place on control column. If necessary, adjust force sensor rod end as follows:
  (a) Cut and remove lock wire.
  (b) Loosen jam nut and adjust rod end to align with control column fitting.
  (c) Tighten jam nut and lock wire.
(4) Secure force sensor to control column with attaching parts.
(5) Connect force sensor electrical connector to aircraft wiring.
(6) Restore electrical power to aircraft.
(7) Install floorboards which were removed to facilitate removal of force sensor.
(8) Perform functional check of elevator control systems to ensure proper operation. (Refer to Chapter 27.)
(9) Perform Mach Trim Operational Check (22-20-00) and AFC/SS Operational Check (22-10-00).





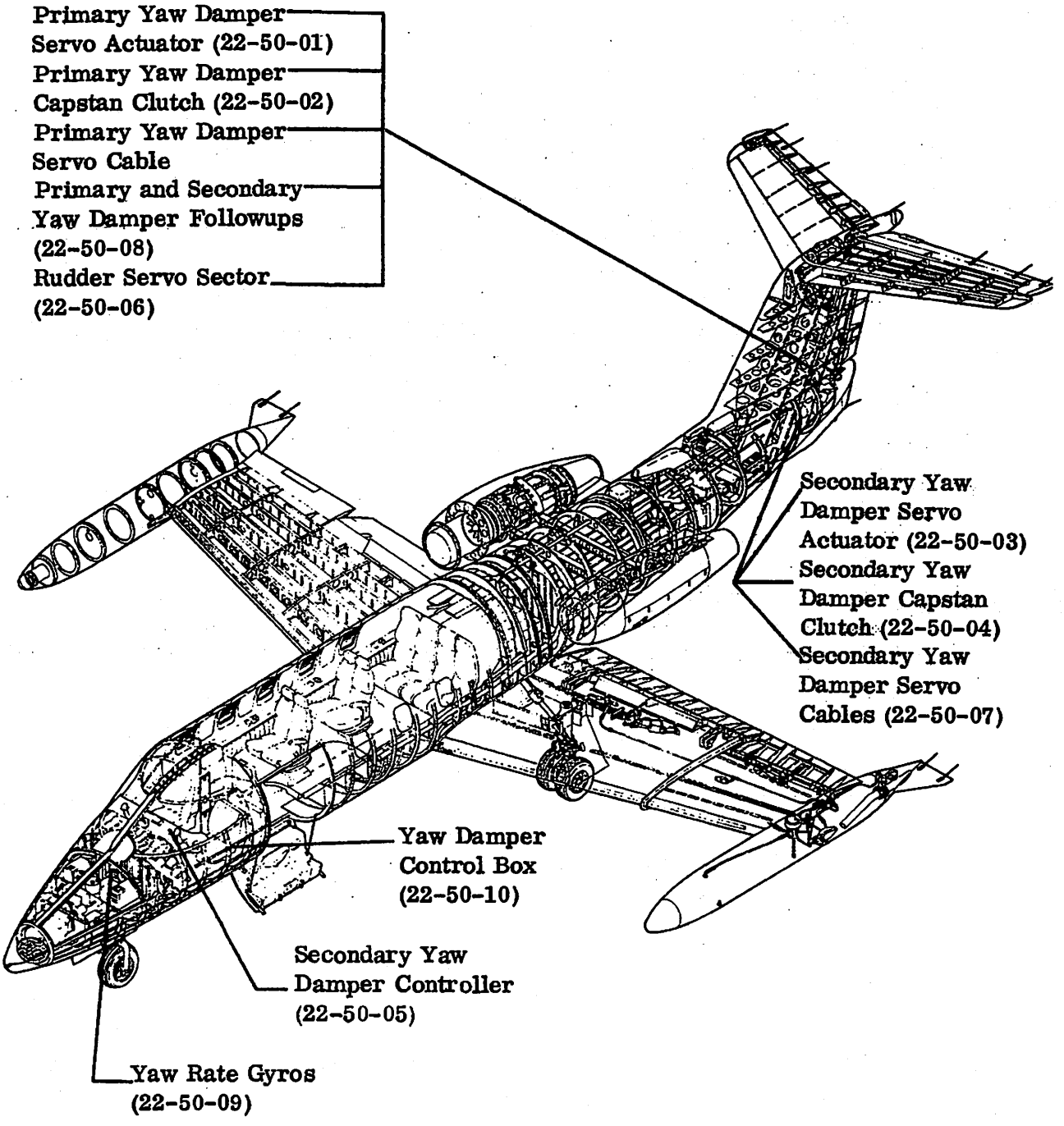
Detail A

8-15C

Force Sensor Installation
Figure 201

YAW DAMPER SYSTEM - DESCRIPTION AND OPERATION

1. Description (See figure 1)
   A. The yaw damper system consists of a primary yaw damper servo actuator, a primary yaw damper capstan clutch, a secondary yaw damper servo actuator, a rudder servo sector, a secondary yaw damper capstan clutch, a secondary yaw damper controller, primary and secondary yaw damper servo cables, primary and secondary yaw damper followups, and two yaw rate gyros, and a yaw damper control box.
   B. Component Description
      (1) The primary yaw damper servo actuator and primary yaw damper capstan clutch are installed just forward of the rudder servo sector in the tailcone.
      (2) The secondary yaw damper servo actuator and secondary yaw damper capstan clutch are located forward of frame 29.
      (3) The secondary yaw damper controller is located in the pedestal.
      (4) The primary yaw damper servo actuator and primary yaw damper capstan clutch are connected to the rudder servo sector by a primary yaw damper servo cable.
      (5) The secondary yaw damper servo actuator and secondary yaw damper capstan clutch are connected to the rudder control cables by a secondary yaw damper servo cable.
      (6) The primary yaw damper followup is attached to the primary yaw damper servo actuator and is mechanically connected to the primary yaw damper capstan clutch drum by the primary yaw damper followup arm.
      (7) The secondary yaw damper followup is attached to aircraft structure just forward of the autopilot sector assembly and is mechanically connected to the autopilot sector assembly by a secondary yaw damper followup arm and link.
      (8) Two yaw rate gyros are installed on a mounting plate located on the forward side of frame 5.
      (9) The yaw damper control box is located between frames 8 and 9 at LBL 7.



Yaw Damper System Components
Figure 1

PRIMARY YAW DAMPER SERVO ACTUATOR - MAINTENANCE PRACTICES

1. Removal/Installation

A. Remove Primary Yaw Damper Servo Actuator (See figure 201)

(1) Remove electrical power from aircraft.

(2) Remove vertical stabilizer access panels and aft tailcone access panels.

(3) Disconnect electrical connector from primary yaw damper servo actuator.

(4) Remove attaching parts and primary yaw damper servo actuator from aircraft.

(5) Cover holes in primary yaw damper servo actuator mounting bracket with tape. This will prevent foreign matter from entering the primary yaw damper capstan clutch gear.

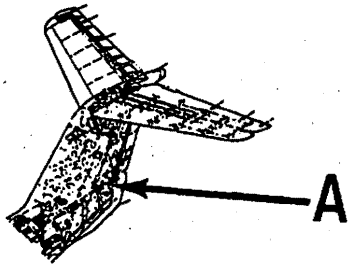
B. Install Primary Yaw Damper Servo Actuator (See figure 201)

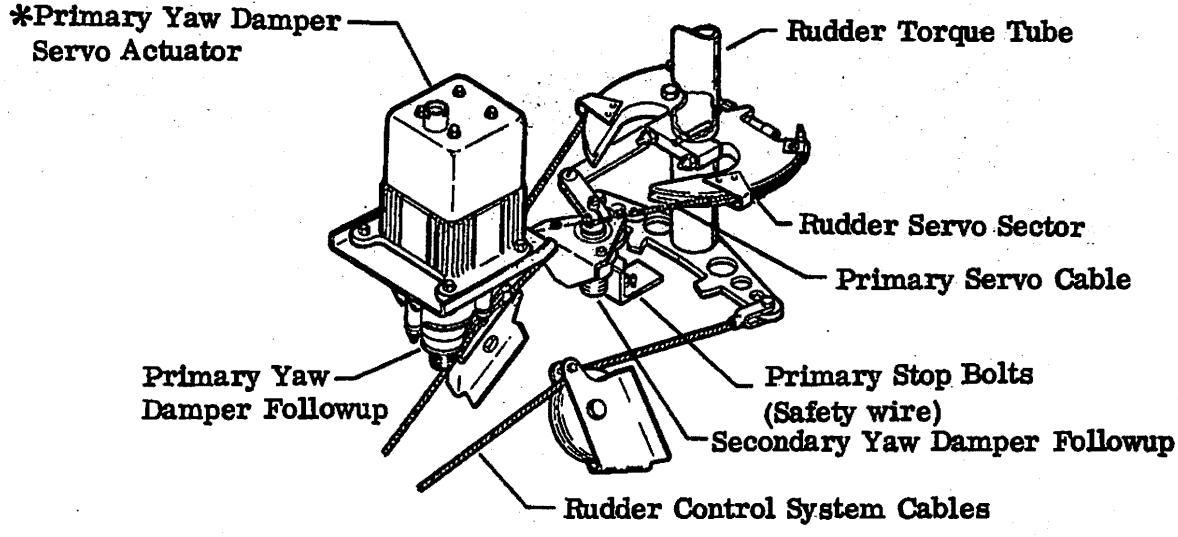
(1) Remove tape, install primary yaw damper servo actuator, and secure with attaching parts.

(2) Connect electrical connector to primary yaw damper servo actuator.

(3) Install vertical stabilizer and aft tailcone access panels.

(4) Restore electrical power to aircraft.





* When primary yaw damper servo actuator is removed, cover holes in mounting bracket with tape. This will prevent foreign matter from entering capstan clutch gear.

Detail A

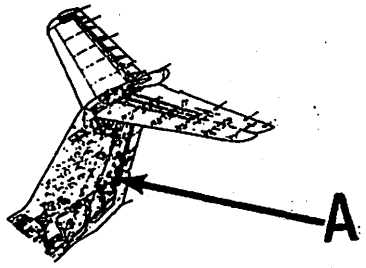
8-39A-3

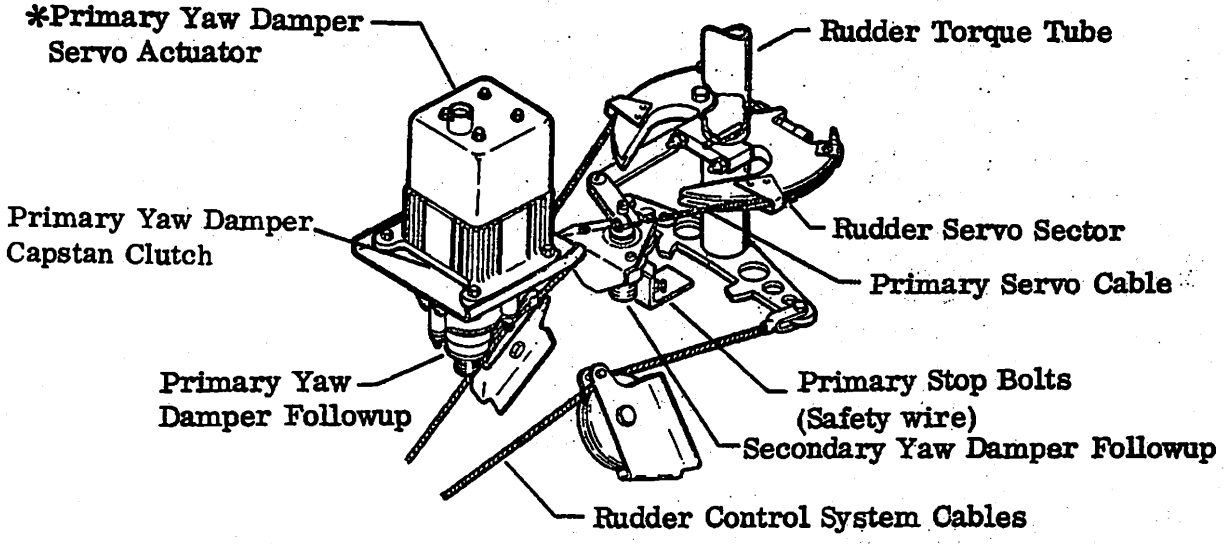
Primary Yaw Damper Servo Actuator Installation
Figure 201

PRIMARY YAW DAMPER CAPSTAN CLUTCH - MAINTENANCE PRACTICES

1. Removal/Installation.
   A. Remove Primary Yaw Damper Capstan Clutch (See figure 201)
      (1) Remove vertical stabilizer and aft tailcone access panels.
      (2) Remove primary yaw damper servo actuator. (Refer to 22-50-01.)
      (3) Place a mark on mounting plate in line with the primary yaw damper servo cable ball retainer hole in cable drum assembly to be used as a locator when installing cable drum assembly.
      (4) Loosen primary yaw damper servo cable at rudder sector.
      (5) Remove attaching parts and shroud from primary yaw damper capstan clutch assembly.
      (6) Unwrap primary yaw damper servo cable from cable drum assembly.
      (7) Remove cable drum assembly from mounting plate.
      (8) Perform capstan clutch adjustment. (Refer to paragraph 2.A.)
   B. Install Primary Yaw Damper Capstan Clutch (See figure 201)
      (1) Install primary yaw damper capstan clutch on mounting plate, assuring that mark on mounting plate is in line with primary yaw damper servo cable ball retainer hole.
      (2) Wrap primary yaw damper servo cable around cable drum assembly.
      (3) Secure ends of primary yaw damper servo cable to rudder servo sector.
      (4) Install shroud over cable drum assembly and secure with attaching parts.

2. Adjustment/Test
   A. Adjust Primary Yaw Damper Capstan Clutch (See figure 202)
      (1) Remove primary yaw damper capstan clutch. (Refer to paragraph 1.A.)
      (2) Place a mark on mounting plate in line with primary yaw damper servo cable ball retainer hole in cable drum assembly to be used later as a locator when installing cable drum assembly.
      (3) Remove primary yaw damper servo actuator from mounting plate.
      (4) Remove shroud with primary yaw damper followup attached from mounting plate. Use care not to damage end of primary yaw damper followup arm when springing primary yaw damper followup arm apart to remove cable drum pin.
      (5) Slide cable drum assembly from mounting plate and remove primary yaw damper servo cable from drum. Use care not to lose primary yaw damper servo cable retainer.
      (6) Place adapter block in vise. Position cable drum assembly in adapter block and secure with adapter pin.
      (7) Attach torque wrench to adapter gear and place adapter gear into cable drum assembly.



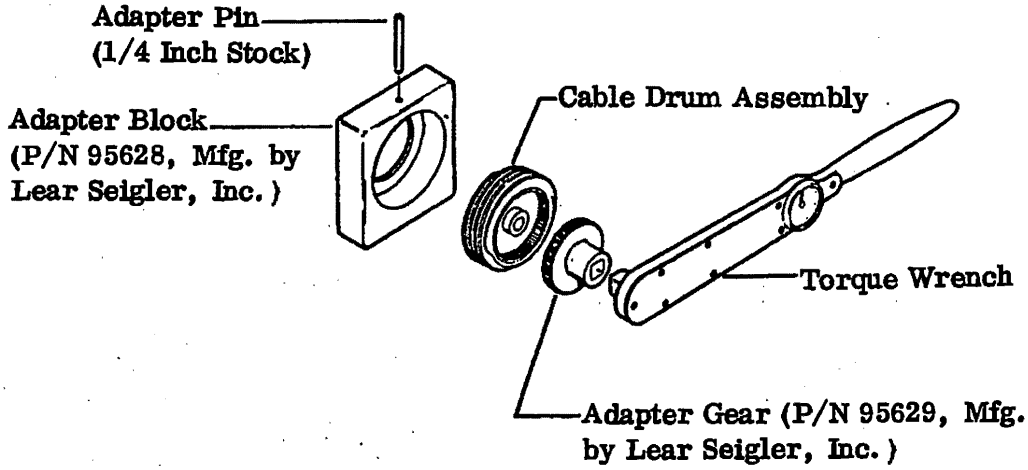


* When primary yaw damper servo actuator is removed, cover holes in mounting bracket with tape. This will prevent foreign matter from entering capstan clutch gear.

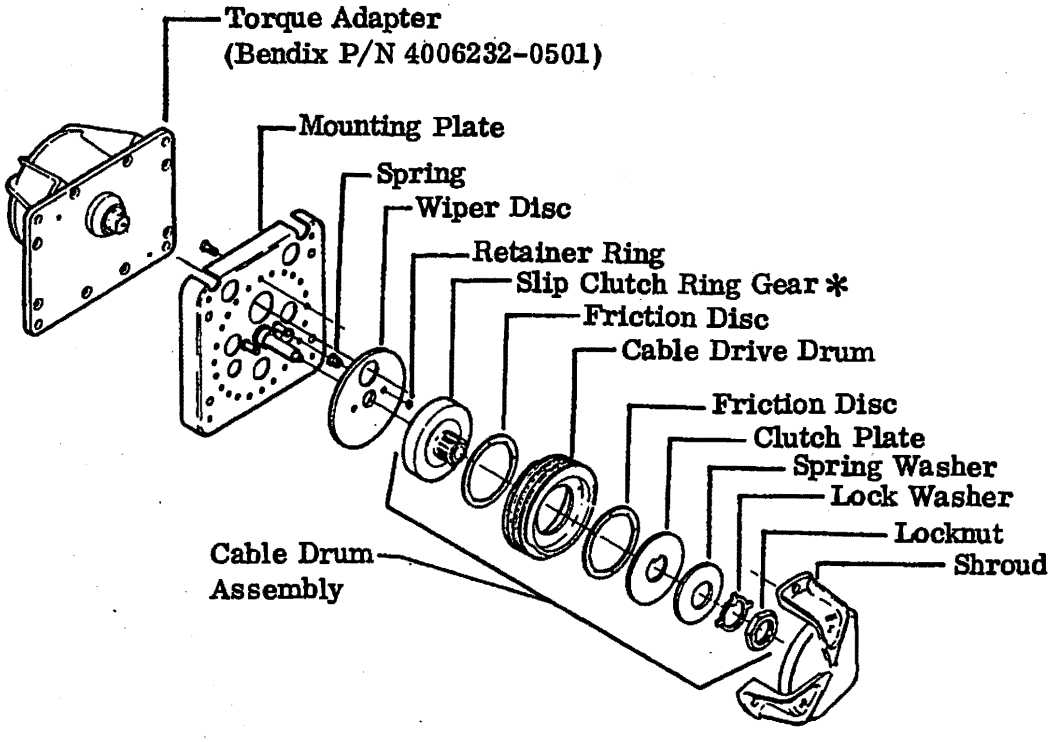
Detail A

8-39A-3

Primary Yaw Damper Capstan Clutch Installation
Figure 201



* Lightly lubricate with MIL-G-81322 Grease.



8-40C

Primary Yaw Damper Capstan Clutch Adjustment
Figure 202

(8) After initial clutch breaking force occurs, move torque wrench left and right through the primary yaw damper capstan clutch travel range.

NOTE: The Bendix (P/N 4006232-0501) torque adapter, when used with yaw axis capstan, has a 5.0:1 torque ratio. With a torque value of 18 to 19.8 inch-pounds applied, the actual slippage torque will be 90 to 99 inch-pounds.

(9) Clutch slippage should occur at 90 to 99 inch-pounds.

(10) Adjust clutch by loosening or lightening lockmut. Tighten lockmut to increase clutch torque; loosen to decrease clutch torque.

NOTE: If the correct clutch torque settings cannot be obtained, disassemble the drum assembly, clean and relubricate the internal surface (both sides) of drum with a light application of Dow Corning No. 33 grease. Reassemble drum assembly and adjust clutch by repeating steps (6) through (10).

(11) Remove cable drum assembly from adapter block. Place cable retainer on cable ball, insert cable retainer in cable drum assembly retainer hole, wrap cable both ways around drum, and temporarily secure loose ends of cable at drum.

SECONDARY YAW DAMPER SERVO ACTUATOR - MAINTENANCE PRACTICES

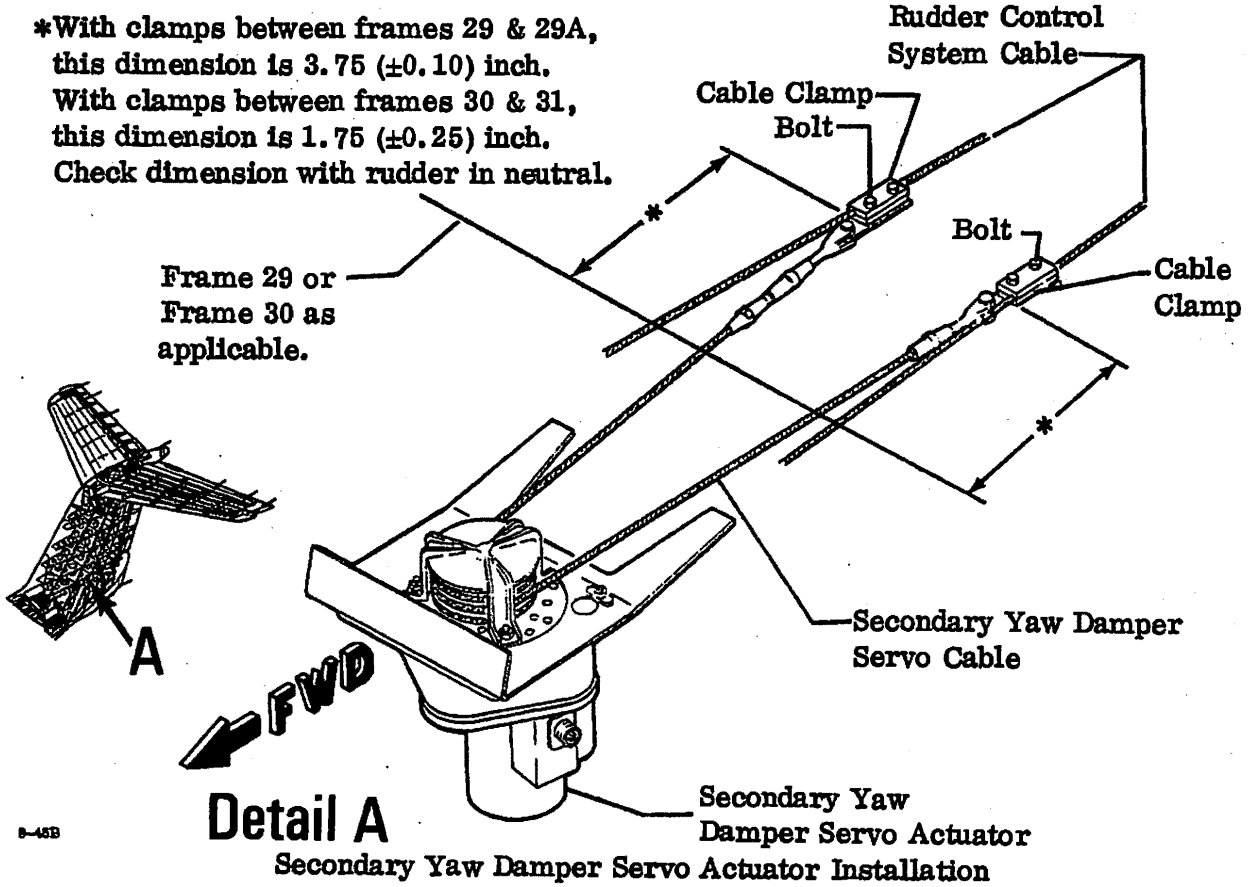
1. Removal/Installation

A. Remove Secondary Yaw Damper Servo Actuator (See figure 201)

(1) Remove electrical power from aircraft.
(2) Lower tailcone access door.
(3) Disconnect electrical connector from secondary yaw damper servo actuator.
(4) Remove attaching parts and secondary yaw damper servo actuator from aircraft.
(5) Cover holes in secondary yaw damper servo actuator mounting bracket with tape.

B. Install Secondary Yaw Damper Servo Actuator (See figure 201)

(1) Remove tape from secondary yaw damper servo actuator mounting bracket.
(2) Install secondary yaw damper servo actuator and secure with attaching parts.
(3) Connect electrical connector to secondary yaw damper servo actuator.
(4) Secure tailcone access door.
(5) Restore electrical power to aircraft.



Secondary Yaw Damper Servo Actuator Installation
Figure 201

SECONDARY YAW DAMPER CAPSTAN CLUTCH - MAINTENANCE PRACTICES

1. Removal/Installation
   A. Remove Secondary Yaw Damper Capstan Clutch (See figure 201)
      (1) Remove secondary yaw damper servo actuator. (Refer to 22-50-03.)
      (2) Place a mark on mounting plate in line with secondary yaw damper servo cable ball retainer hole in cable drum assembly to be used as a locator when installing cable drum assembly.
      (3) Loosen secondary yaw damper servo actuator cable turnbuckle.
      (4) Remove attaching parts and shroud from cable drum assembly.
      (5) Unwrap secondary yaw damper servo actuator cable from cable drum assembly.
      (6) Remove cable drum assembly from aircraft.
   B. Install Secondary Yaw Damper Capstan Clutch (See figure 201)
      (1) Install secondary yaw damper capstan clutch on secondary yaw damper servo actuator, assuring that the secondary yaw damper servo cable ball retainer hole and mark are aligned.
      (2) Wrap secondary yaw damper servo actuator cable around cable drum assembly.
      (3) Secure secondary yaw damper servo actuator cable to rudder control cables.
      (4) Install shroud over cable drum assembly and secure with attaching parts.
      (5) With rudder control system in neutral, adjust cable tension to 65 (±5) pounds. (Refer to Chapter 27, for cable tension temperature loading chart.)

      NOTE: On some aircraft the secondary yaw damper servo actuator clamps are located between frames 29 and 29A while on others the clamps are located between 30 and 31.

      (6) On aircraft with secondary yaw damper cable clamps installed between frames 29 and 29A, deflect rudder to both full left and full right position while observing cable movement through frame 29A. Assure that a minimum of 0.50-inch clearance exists between each cable clamp bolt and frame 29A near lightening hole.
      (7) With rudder in neutral position, check dimension between each cable and frame as shown in figure 201.
      (8) Install secondary yaw damper servo actuator. (Refer to 22-50-03.)

2. Adjustment/Test
   A. Adjust Secondary Yaw Damper Capstan Clutch (See figure 202)
      (1) Remove electrical power from aircraft.
      (2) Open tailcone access door, gain access to secondary yaw damper servo actuator and disconnect electrical connector from secondary yaw damper servo actuator.

(3) Remove secondary yaw damper servo actuator from mounting plate.

NOTE: The Bendix (P/N 4006232-0501) torque adapter, when used with yaw axis capstan, has a 5.0:1 torque ratio. With a torque value of 18 to 19.8 inch-pounds applied, the actual slippage torque will be 90 to 99 inch-pounds.

(4) Move rudder pedals through full range of travel. After initial breaking force occurs, clutch slippage shall occur at 90 to 99 inch-pounds (18 to 19.8 inch-pounds, when using a Bendix P/N 4006232-0501 adapter). If clutch slippage does not occur at this value, disconnect secondary yaw damper servo cables from cable drum, remove cable drum from secondary yaw damper capstan and proceed as follows:

(a) Place adapter block in vise. Position cable drum assembly in adapter block and secure with adapter pin.

(b) Attach torque wrench to adapter gear and place adapter gear in gear drum assembly.

(c) After initial clutch breaking force occurs, move torque wrench left and right through entire clutch travel range.

(d) Clutch slippage shall occur at 90 to 99 inch-pounds (18 to 19.8 inch-pounds when using torque adapter, Bendix P/N 4006232-0501).

(e) Adjust clutch by loosening or tightening locknut. Tighten locknut to increase clutch torque; loosen locknut to decrease clutch torque.

NOTE: If the correct clutch settings cannot be obtained, disassemble the drum assembly, clean and relubricate the internal surface (both sides) of drum with a light application of Dow Corning No. 33 grease. Reassemble drum assembly and adjust slip clutch by repeating steps (a) through (e).

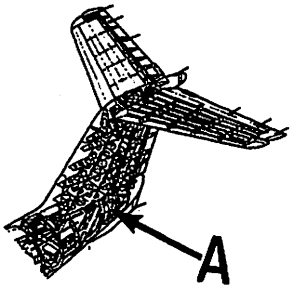
(f) Remove cable drum assembly from adapter block. Place secondary yaw damper servo cable retainer on cable ball, insert secondary yaw damper servo cable in cable drum assembly retainer hole, wrap both ways around drum, and temporarily secure loose ends of secondary yaw damper servo cable at drum.

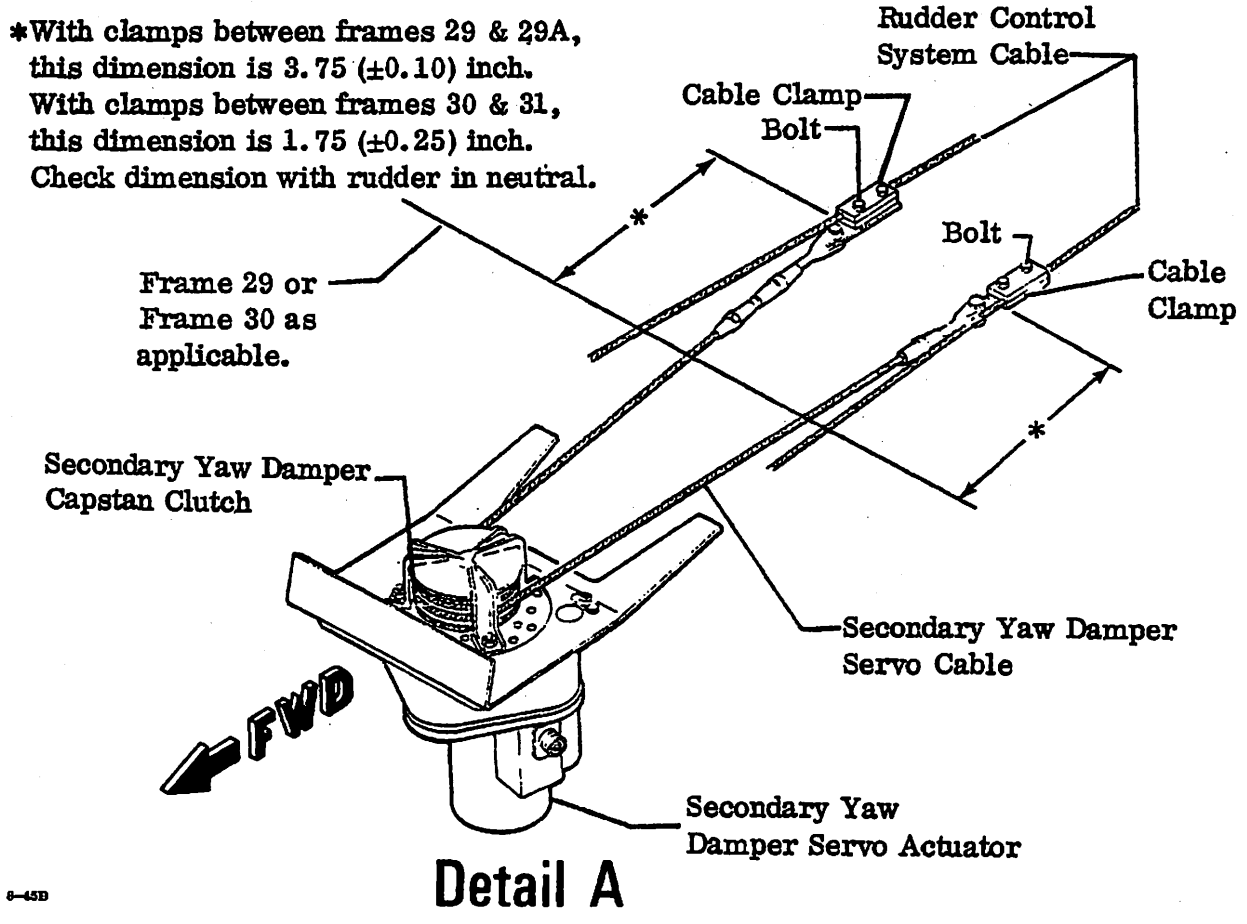
(g) Clean and relubricate the mounting plate center stud with MIL-G-81322 grease or equivalent.

(5) Install secondary yaw damper servo actuator on mounting plate and secure with attaching parts.

(6) Connect electrical connector to secondary yaw damper servo actuator.

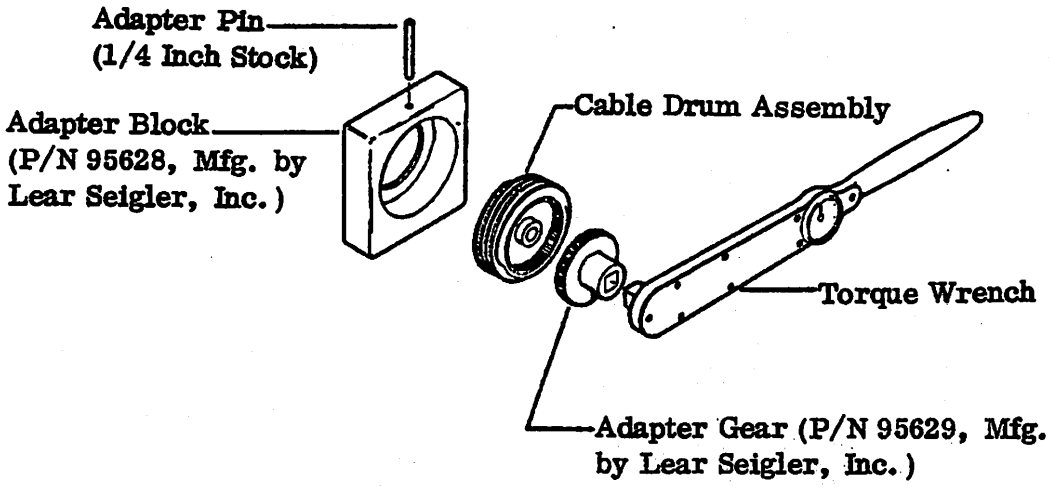
(7) Adjust secondary yaw damper servo cables, as necessary, to 65 (±5) pounds at 75°F. (Refer to Chapter 27, for cable tension-temperature load correction chart.)
(8) Close tailcone access door.
(9) Restore electrical power to aircraft.



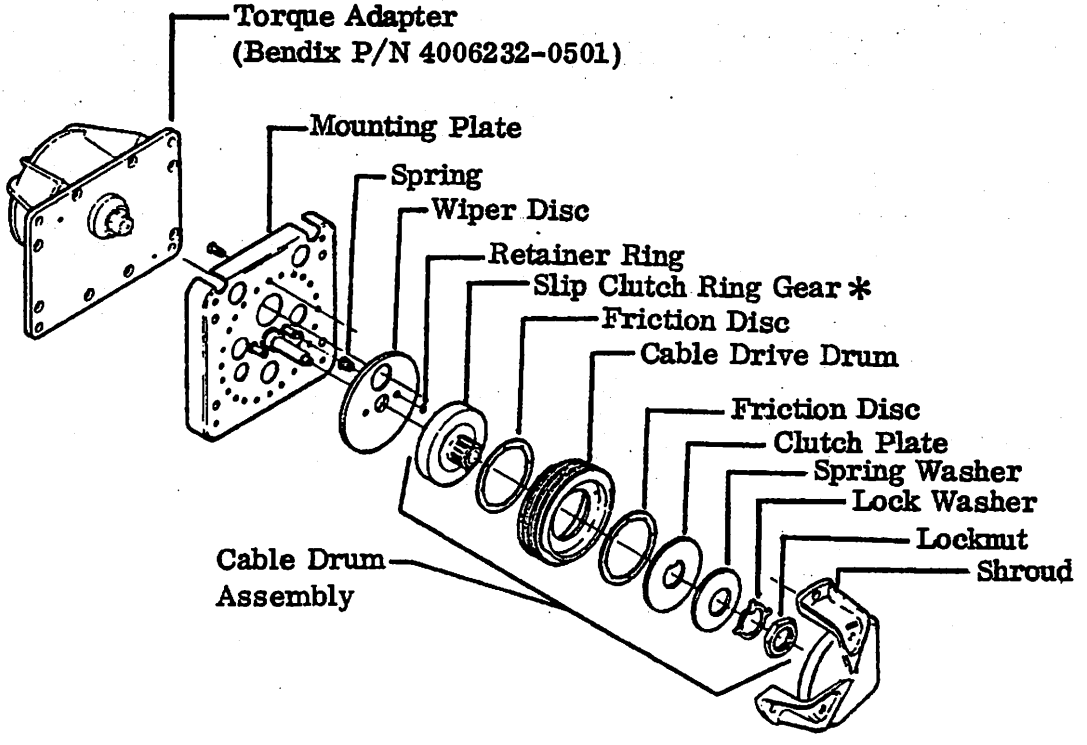


Secondary Yaw Damper Capstan Clutch Installation
Figure 201

EFFECTIVITY: ALL



* Lightly lubricate with MIL-G-81322 Grease.



8-40C

Secondary Yaw Damper Capstan Slip Clutch Adjustment
Figure 202

SECONDARY YAW DAMPER CONTROLLER - MAINTENANCE PRACTICES

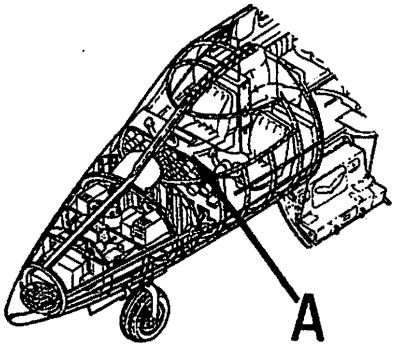
1. Removal/Installation

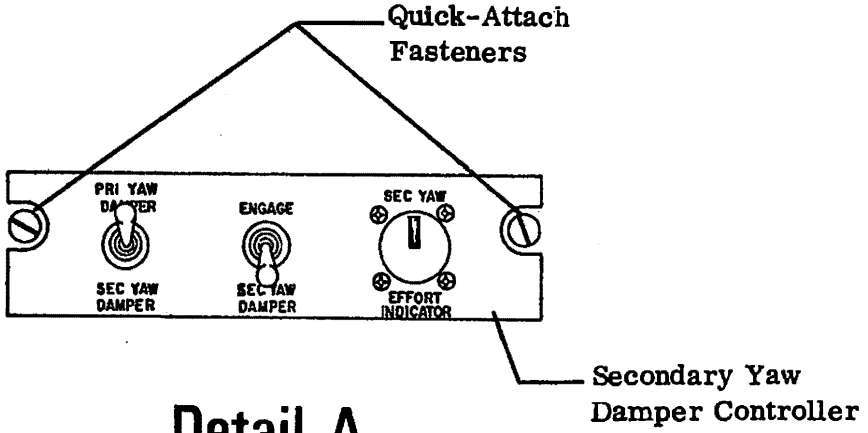
A. Remove Secondary Yaw Damper Controller (See figure 201.)

(1) Remove electrical power from aircraft.
(2) Release quick-attach fasteners.
(3) Remove secondary yaw damper controller sufficiently to gain access to electrical connector.
(4) Disconnect electrical connector and remove secondary yaw damper controller.

B. Install Secondary Yaw Damper Controller (See figure 201.)

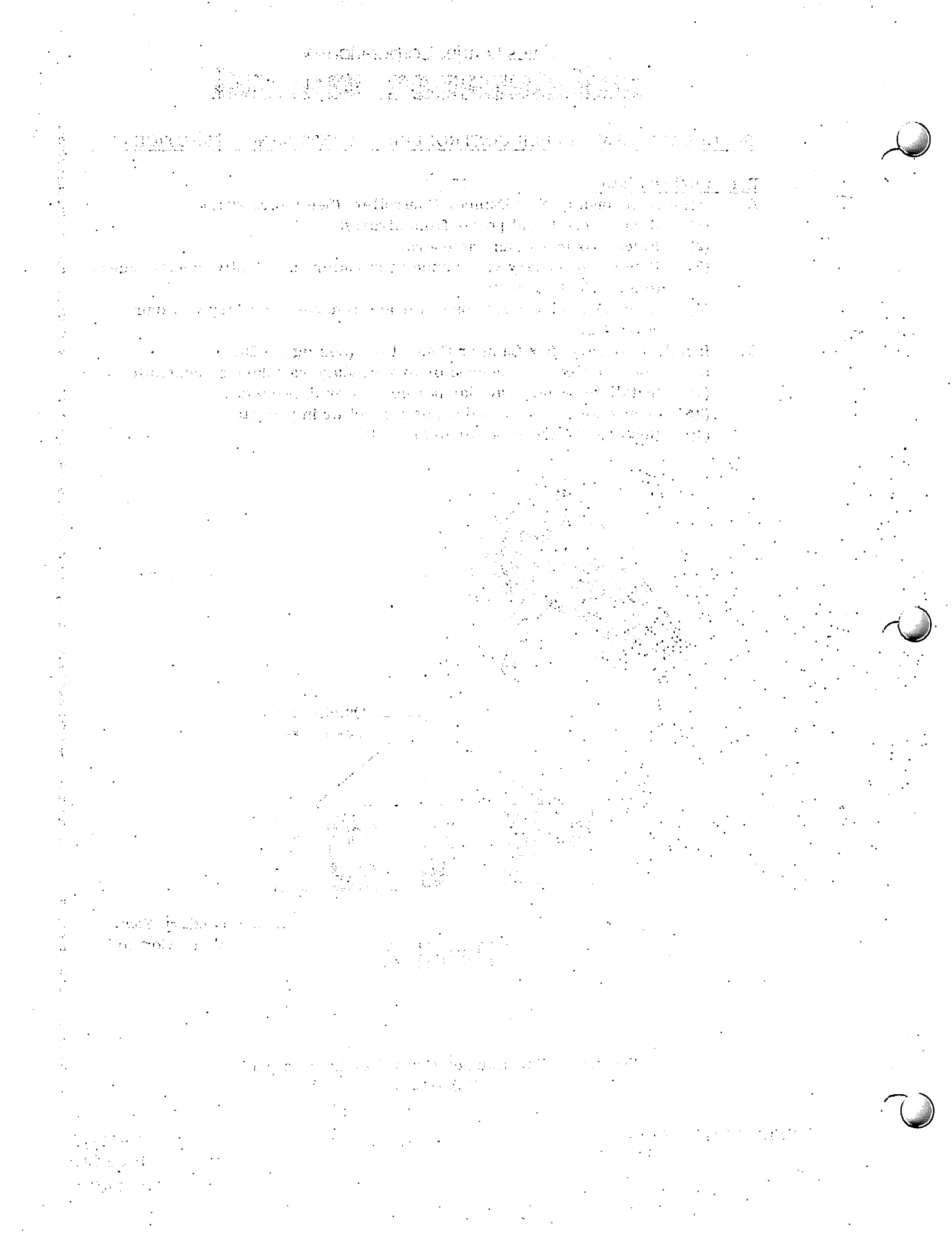
(1) Connect electrical connector to secondary yaw damper controller.
(2) Install secondary yaw damper controller in pedestal.
(3) Secure secondary yaw damper controller in pedestal.
(4) Restore electrical power to aircraft.





Detail A

Secondary Yaw Damper Controller Installation
Figure 201



RUDDER SERVO SECTOR - MAINTENANCE PRACTICES

1. Removal/Installation

A. Remove Rudder Servo Sector (See figure 201)

(1) Remove electrical power from aircraft.

(2) Remove floorboards, as required, to gain access to rudder pedal bellcrank. Insert rigging pin in rudder pedal bellcrank.

(3) Remove rudder servo sector and bellcrank access cover from tailcone.

(4) Remove primary yaw damper servo cable turnbuckle nut, clip and cotter pin, releasing primary yaw damper servo cable ends from rudder servo sector.

(5) Remove attaching parts from rudder servo sector, releasing rudder servo sector and cap from rudder torque tube.

B. Install Rudder Servo Sector (See figure 201)

(1) Align rudder servo sector on aft side of rudder torque tube. Assure that spring pin through torque tube engages pin hole in rudder servo sector.

NOTE: The rudder servo sector is not symmetrical, therefore, it must be installed with the correct side up. The rudder servo sector will have the correct side up when the screw hole for the primary yaw damper servo cable clip is on LH side of aircraft.

(2) Align rudder servo sector cap on forward side of rudder torque tube. Assure that spring pin through torque tube engages pin hole in cap.

(3) Install one washer on each bolt and insert bolts through rudder servo sector and cap from aft side.

(4) Install washer and nut on each bolt and alternately torque nuts to 50-70 inch-pounds.

(5) Route primary yaw damper servo cable around RH side of rudder servo sector, insert turnbuckle threads through hole in rudder servo sector, and secure with nut.

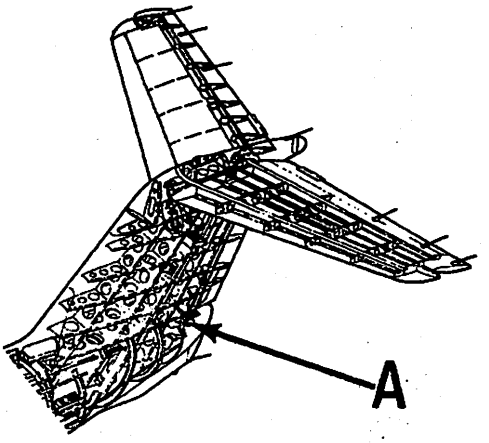
(6) Install cable retaining cotter pin through hole in right half of rudder servo sector.

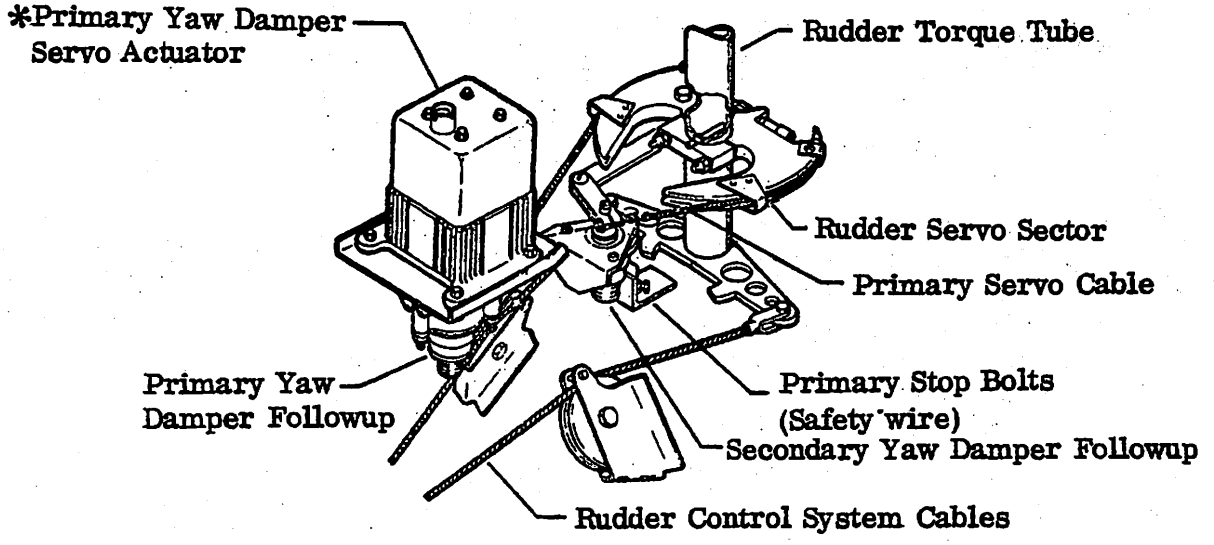
(7) Route other primary yaw damper servo cable around LH side or rudder servo sector and secure with clip and attaching parts.

(8) Adjust primary yaw damper servo cable tension to 25 (±5) pounds at 75°F. (Refer to Chapter 27, for cable tension temperature-load correction chart.)

(9) Install access covers on tailcone.

(10) Remove rigging pin from rudder bellcrank and install floorboards.





* When primary yaw damper servo actuator is removed, cover holes in mounting bracket with tape. This will prevent foreign matter from entering capstan clutch gear.

8-39A-3

Detail A

Rudder Servo Sector Installation
Figure 201

SECONDARY YAW DAMPER SERVO CABLE - MAINTENANCE PRACTICES

1. Removal/Installation

A. Remove Secondary Yaw Damper Servo Cables (See figure 201)

(1) Remove electrical power from aircraft.

(2) Lower tailcone access door.

(3) Remove shroud over secondary yaw damper cable drum assembly. Observe manner in which cable is wrapped around drum for reinstallation reference.

(4) Remove parts which secure each end of secondary yaw damper servo cable to cable clamps.

B. Install Secondary Yaw Damper Servo Cable (See figure 201)

NOTE: If replacement cable is a longer cable than the original, cable must be moved on the rudder cable. Clamp location for the short cable is 3.75 (±0.10) inch aft of frame 29. Clamp location for the long cable is 1.75 (±0.25) inch aft of frame 30.

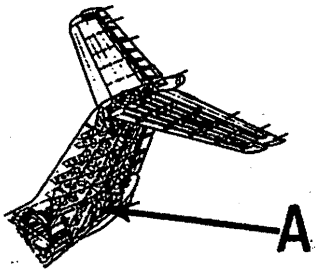
(1) Wrap secondary yaw damper servo cable around cable drum in the same manner as it was installed prior to removal.

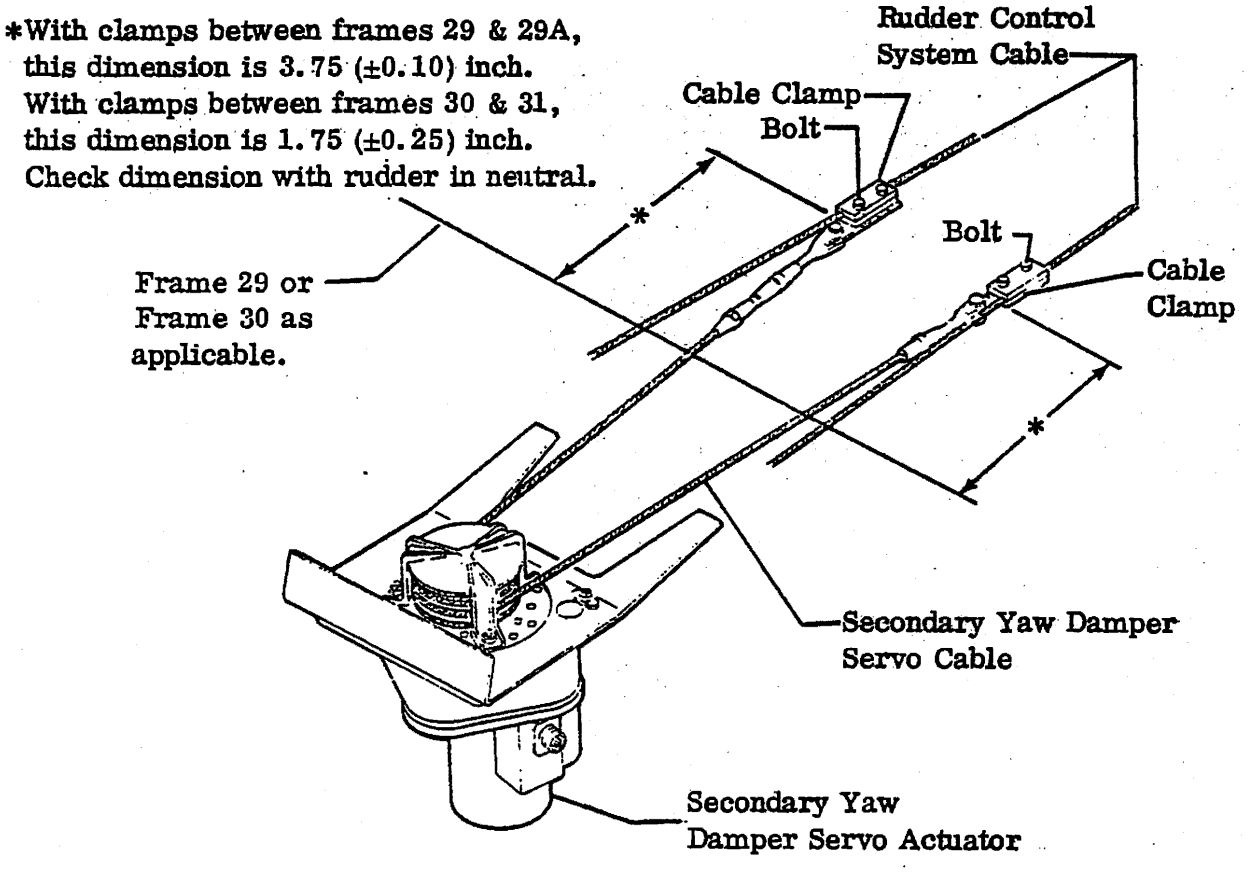
(2) Secure secondary yaw damper servo cable to cable clamps with attaching parts.

(3) Adjust secondary yaw damper servo cable tension to 65 (±5) pounds. (Refer to Chapter 27, for cable tension temperature-load correction chart.)

(4) With the rudder in neutral position, check dimension between each cable clamp and frame as shown in figure 201.

(5) Deflect rudder to both full left and full right position while observing cable movement through frames. Assure that cable clamp bolts clear all structure at least 0.50 inch.





Detail A

8-45B

Secondary Yaw Damper Servo Cable Installation
Figure 201

YAW DAMPER SYSTEM FOLLOWUPS - MAINTENANCE PRACTICES

1. Removal/Installation

A. Remove Primary Yaw Damper Followup (See figure 201)

(1) Remove electrical power from aircraft.

(2) Remove floorboards, as required, and insert rigging pin in rudder pedal bellcrank.

(3) Gain access to primary yaw damper followup.

(4) Disconnect electrical connector from primary yaw damper followup.

CAUTION: USE CARE NOT TO DAMAGE PRIMARY YAW DAMPER FOLLOWUP ARM WHEN REMOVING ARM FROM PRIMARY YAW DAMPER FOLLOWUP SHAFT.

(5) Remove primary yaw damper followup from primary yaw damper servo actuator shroud and primary yaw damper followup arm. Use care not to damage primary yaw damper followup arm when springing arm apart to remove primary yaw damper followup shaft.

B. Install Primary Yaw Damper Followup (See figure 201)

NOTE:
- For primary yaw damper followup (P/N 117086-01), install primary yaw damper followup on primary yaw damper servo actuator shroud and followup arm on followup shaft using attaching parts.
- For primary yaw damper followup (P/N 509-1005-01), align red dot on housing with red dot on shaft. Install primary yaw damper followup on primary yaw damper servo actuator shroud and followup arm on followup shaft using attaching parts.

(1) Install primary yaw damper followup and secure with attaching parts.

(2) Connect electrical connector to primary yaw damper followup.

(3) Restore electrical power to aircraft.

(4) Perform adjustment of primary yaw damper followup. (Refer to paragraph 2.A.)

(5) Ensure that rigging pin has been removed from the rudder pedal bellcrank and install previously removed access covers.

C. Remove Secondary Yaw Damper Followup (See figure 201)

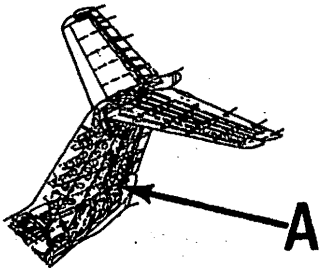
(1) Remove electrical power from aircraft.

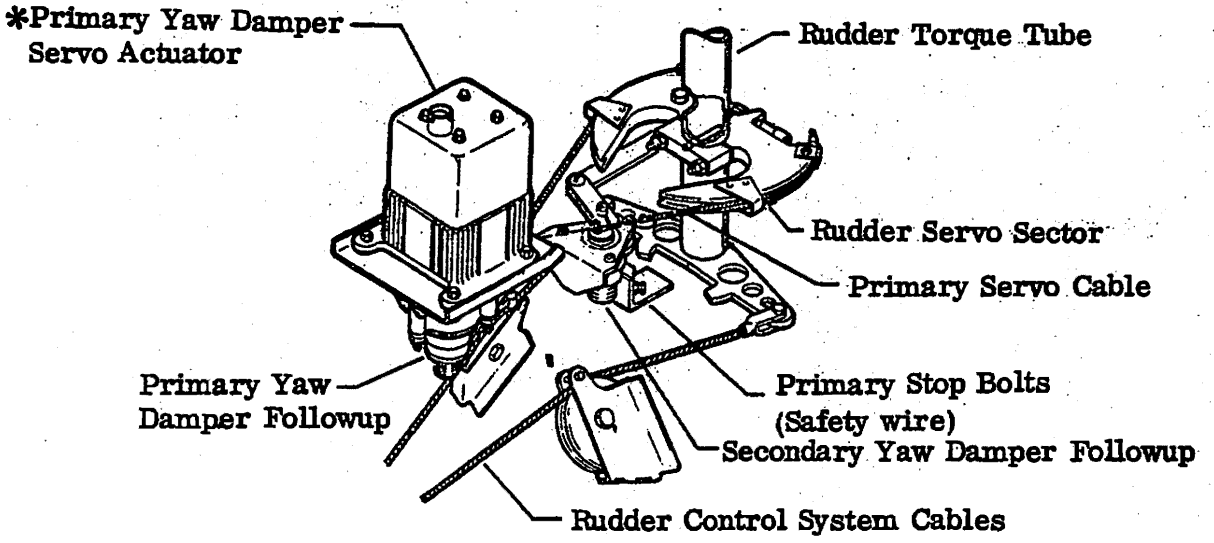
(2) Remove floorboard, as required, and insert rigging pin in rudder pedal bellcrank.

(3) Gain access to secondary yaw damper followup.

(4) Disconnect electrical connector from secondary yaw damper followup.

(5) Remove secondary yaw damper followup arm from secondary yaw damper followup shaft.





* When primary yaw damper servo actuator is removed, cover holes in mounting bracket with tape. This will prevent foreign matter from entering capstan clutch gear.

Detail A

8-39A-3

Primary and Secondary Yaw Damper Followup Installation
Figure 201

(6) Remove attaching parts and secondary yaw damper followup from aircraft.

D. Install Secondary Yaw Damper Followup (See figure 201).

NOTE: Assure that Loctite Screw-Lock is applied to secondary yaw damper followup housing clamp screws and screws are tight. With replacement secondary yaw damper followup (P/N 509-1005-01), align red dot on housing with red dot on shaft.

(1) Install secondary yaw damper followup and secure with attaching parts.
(2) Connect electrical connector to secondary yaw damper followup.
(3) Install secondary yaw damper followup arm on secondary yaw damper followup shaft.
(4) Restore electrical power to aircraft.
(5) Perform adjustment of secondary yaw damper followup. (Refer to paragraph 2.B.)

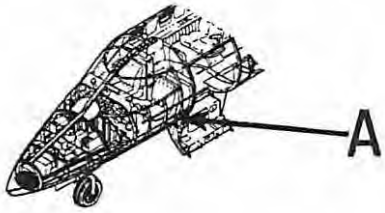
2. Adjustment/Test

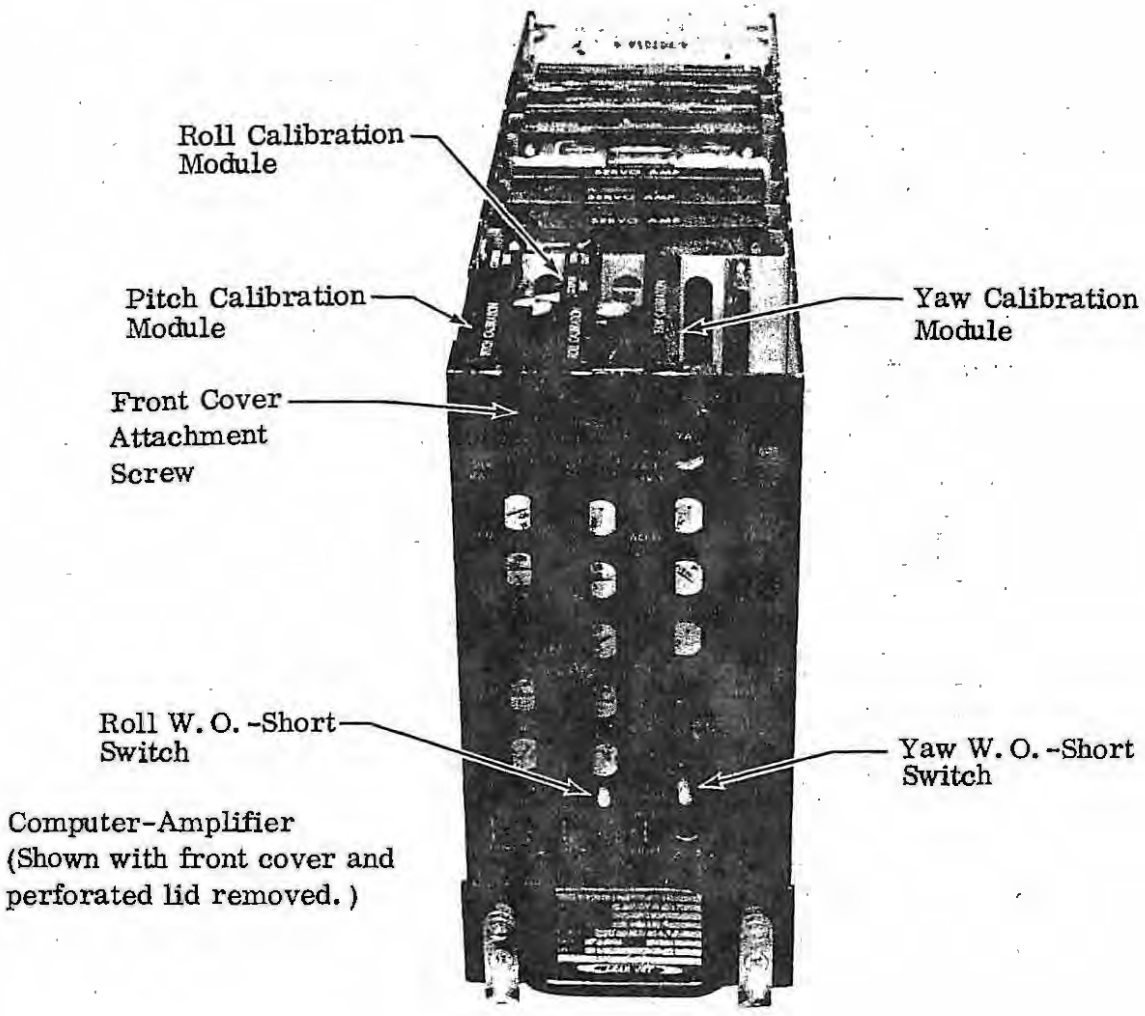
A. Primary Yaw Damper Adjustment (See figure 202)

(1) Remove computer-amplifier from rack (refer to 22-10-04) and remove computer-amplifier perforated lid.
(2) Fabricate a jumper wire approximately 2 feet long of insulated AWG 24 wire by stripping insulation from both ends.
(3) Remove yaw calibration module from computer-amplifier, locate pin 13, and secure one end of jumper wire fabricated in step (2) to pin 13.
(4) Install yaw calibration modules in computer-amplifier and install computer-amplifier in rack. (Refer to 22-10-06.)
(5) Remove computer-amplifier front cover and set YAW W.O.-SHORT switch to SHORT.

NOTE: Primary yaw damper followup output is an AC signal and is measured in millivolts. Adjust sensitivity of voltmeter to read in millivolts.

(6) Connect a voltmeter (Hewlett Packard Model 3430A or Simpson type 260) to jumper wire and aircraft ground. Set Battery and Primary Inverter Switch on. Loosen clamp screws sufficiently to allow primary yaw damper followup housing to be turned by hand. DO NOT USE PLIERS OR WRENCH to turn primary yaw damper following housing. Adjust primary yaw damper followup housing until voltmeter indicates zero voltage. Only a slight adjustment shall be required to zero voltmeter. With replacement primary yaw damper followup (P/N 509-1005-01), assure that red dots are aligned with zero voltage indicated. Tighten clamp screws. Remove rigging pin, set Primary and Secondary Yaw Damper Select Switch to PRI and depress Yaw Damper Select Switch to PRI and depress Yaw Damper ON pushbutton on autopilot controller.





Detail A

Primary Yaw Damper Followup Calibration and Adjustment
Figure 202

(7) With primary yaw damper engaged, move rudder pedals for either right or left rudder. With replacement primary yaw damper followup (P/N 117086-01), if rudder pedals go hard over, primary yaw damper followup shaft is turned 180° and step (8) must be performed. If rudder pedals return to neutral, proceed to step (9). With replacement primary yaw damper followup (P/N 509-1005-01), rudder pedals will return to neutral. Proceed to step (9).

(8) Depress Yaw Damper OFF pushbutton on autopilot controller and insert rigging pins in rudder bellcrank. Loosen clamp screws securing primary yaw damper followup housing to mounting plate. Rotate primary yaw damper followup housing 180°. Null primary yaw damper followup by adjusting primary yaw damper followup housing until voltmeter indicates zero voltage. Tighten clamp screws.

(9) Set W. O. -SHORT Switch on computer-amplifier to W. O. and set Battery and Primary Inverter Switches to OFF.

(10) Remove computer-amplifier from rack (refer to 22-10-04). Remove yaw calibration module from computer-amplifier and disconnect jumper wire from pin 13.

(11) Install yaw calibration module in computer-amplifier and install perforated lid on computer-amplifier.

(12) Install computer-amplifier in rack and secure with retaining clamps.

(13) Assure that clamp screws are tight on primary yaw damper followup housing. Remove primary yaw damper servo actuator (refer to 22-50-01).

(14) Remove one clamp screw at a time from primary yaw damper followup housing. Apply Loctite Screw. Lock to screw and install screw. Repeat procedure on each clamp screw.

(15) Install primary yaw damper servo actuator (refer to 22-10-04).

B. Secondary Yaw Damper Followup Adjustment (See figure 203)

NOTE: The secondary yaw damper control box is secured to the outboard side of computer-amplifier rack.

(1) Remove door from forward end of secondary yaw damper control box.

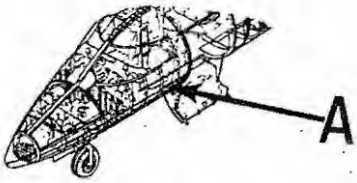
(2) Fabricate a jumper wire approximately 2 feet long of insulated AWG 14 wire by stripping insulation from both ends.

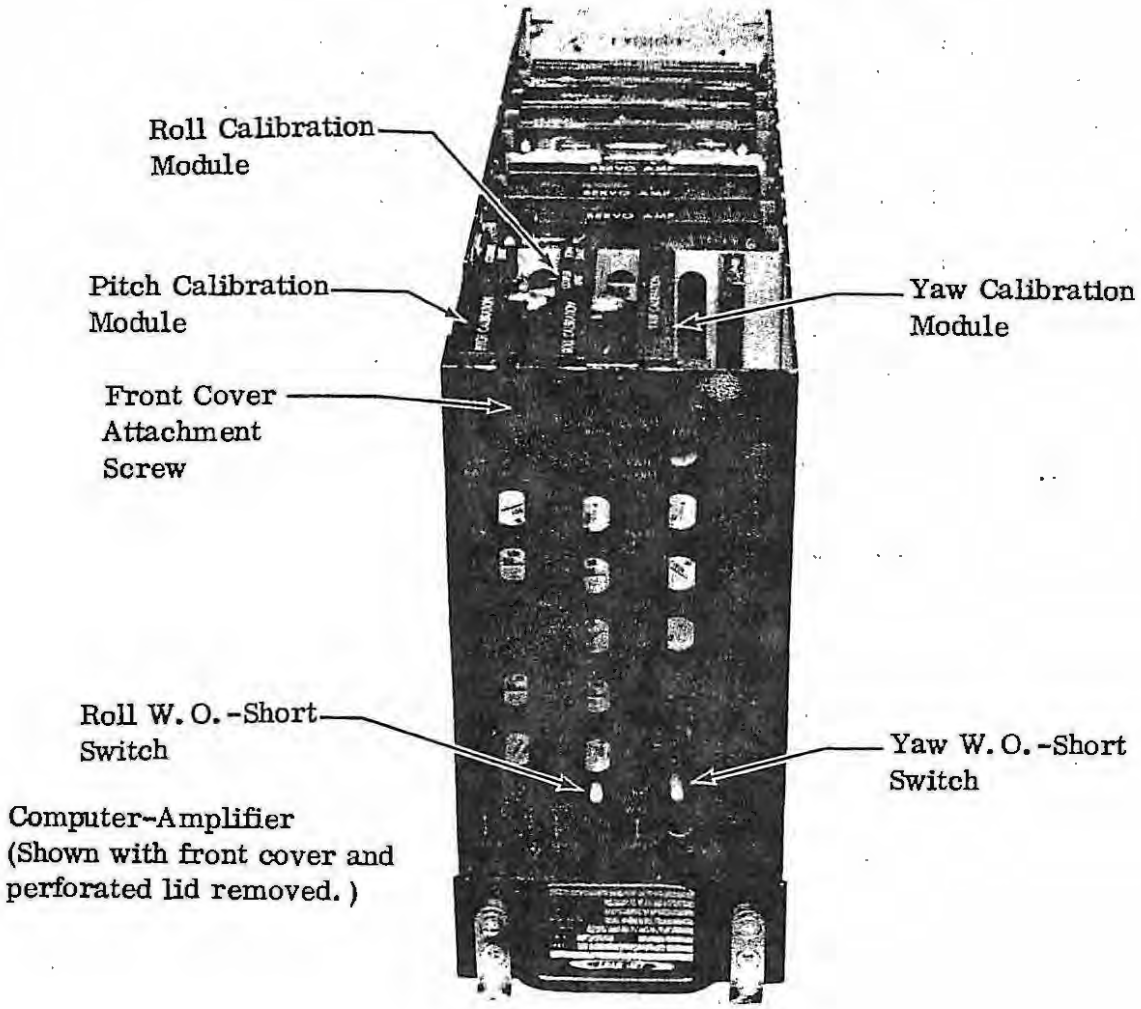
(3) Remove yaw calibration module from secondary yaw damper control box.

(4) Install yaw calibration module in secondary yaw damper box.

(5) Remove cover panel from secondary yaw damper control box and set W.O.-SHORT Switch, located on secondary yaw calibration module, to SHORT.

NOTE: Secondary yaw damper followup output is an AC signal and is measured in millivolts. Adjust sensitivity of voltmeter to read in millivolts.





Detail A

Secondary Yaw Damper Followup Calibration and Adjustment
Figure 203

(6) Connect a voltmeter (Hewlett Packard Model 3430A or Simpson type 260) to jumper wire and aircraft ground. Set Battery and Secondary Inverter Switches on. Set Primary and Secondary Yaw Damper Select Switch to SEC. Loosen secondary yaw damper followup arm on follow-up shaft and adjust secondary yaw damper followup until voltmeter indicates zero voltage. Only a slight adjustment shall be required to zero voltmeter. With replacement secondary yaw damper followup (P/N 509-1005-01), assure that red dots are aligned. With zero voltage indicated, secondary yaw damper is nulled. Secure secondary yaw damper followup arm on followup shaft, remove rudder rigging pin and set Secondary Yaw Damper Engage Switch to ENGAGE.

(7) With secondary yaw damper engaged, move rudder for either right or left rudder. With replacement secondary yaw damper followup (P/N 117086-01), if rudder pedals go hard over, secondary yaw damper followup shaft is turned 180° and step (8) must be performed. If rudder pedals return to neutral, proceed to step (9). With replacement secondary yaw damper followup (P/N 509-1005-01), rudder pedals will return to neutral, proceed to step (9).

(8) Set Secondary Yaw Damper Engage Switch to SEC YAW DAMPER and and insert rigging pin in rudder bellcrank. Loosen secondary yaw damper followup arm on shaft and rotate 180°. Null secondary yaw damper followup by adjusting shaft until voltmeter indicates zero voltage. Tighten secondary yaw damper followup arm on shaft and remove rudder rigging pin.

(9) Set YAW W.O.-SHORT Switch on secondary yaw calibration module to W.O. Set Primary and Secondary Yaw Damper Select Switch to PRI. Set Battery and Secondary Inverter Switches off.

(10) Remove secondary yaw calibration module from secondary yaw damper control box, disconnect jumper wire from pin 13, and install secondary yaw calibration module in secondary yaw damper control box.

(11) Install door on forward end of secondary yaw damper control box and cover panel.

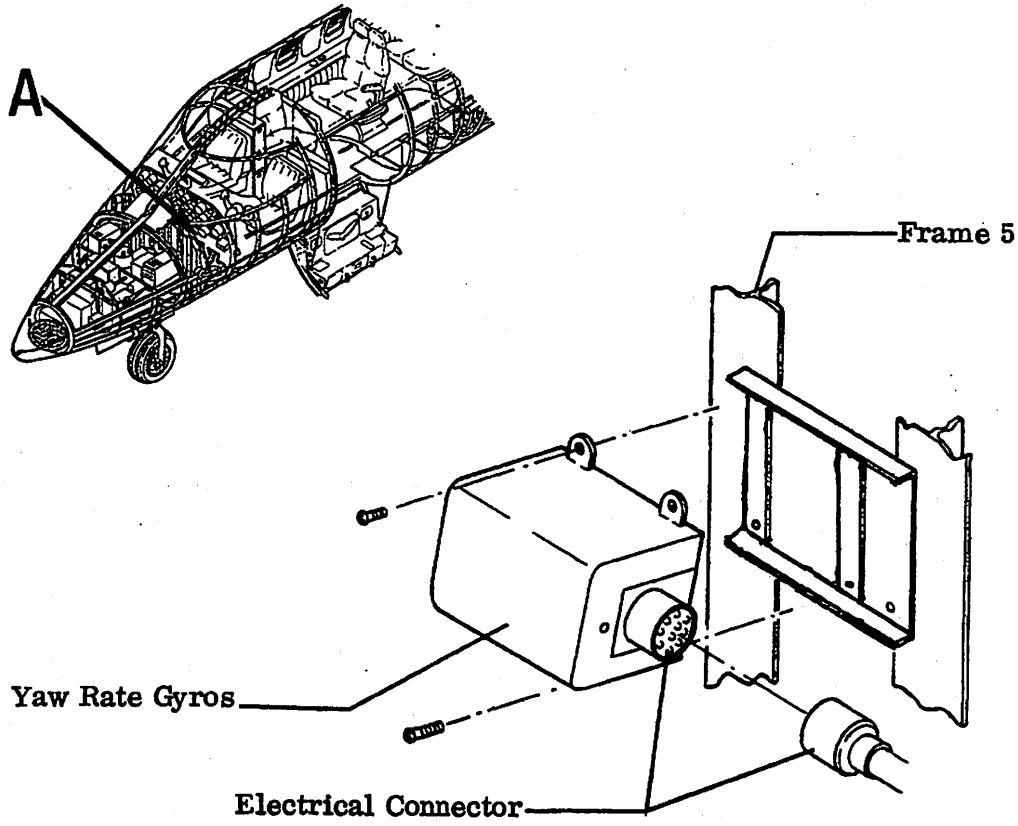
YAW RATE GYRO - MAINTENANCE PRACTICES

1. Removal/Installation

NOTE: The removal and installation instructions for both gyros are identical.

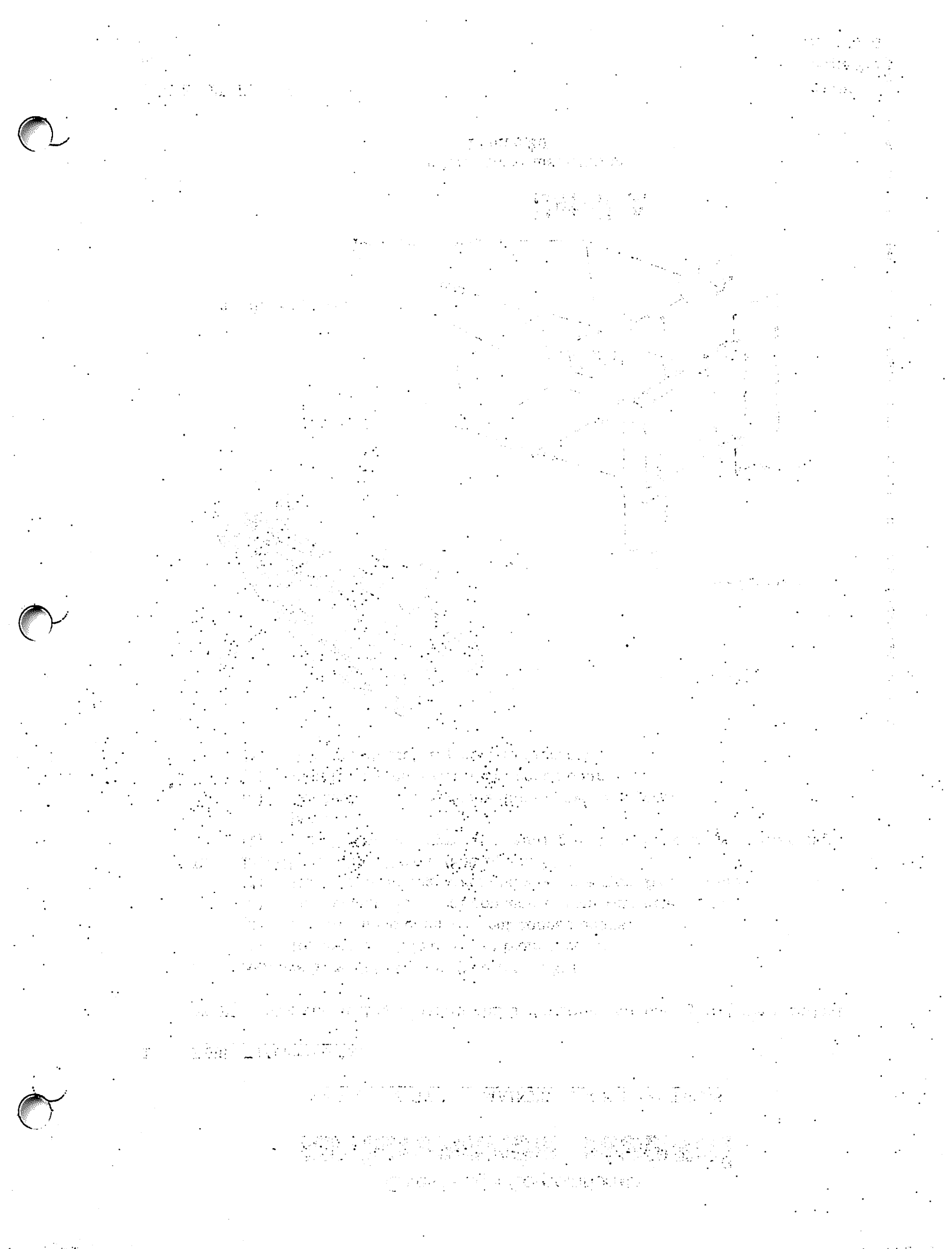
A. Remove Yaw Rate Gyros (See figure 201)
   (1) Remove electrical power from aircraft.
   (2) Remove nose compartment access doors.
   (3) Disconnect electrical connector from yaw rate gyro.
   (4) Remove attaching parts and yaw rate gyro from frame 5.

B. Install Yaw Rate Gyros (See figure 201)
   (1) Install yaw rate gyro on mounting plate and secure with attaching parts.
   (2) Connect electrical connector to yaw rate gyro.
   (3) Install nose compartment access door.
   (4) Restore electrical power to aircraft.



W14-161B

Yaw Rate Gyro Installation
Figure 201



YAW DAMPER CONTROL BOX - MAINTENANCE PRACTICES

1. Removal/Installation

A. Remove Yaw Damper Control Box (See figure 201)

(1) Remove electrical power from aircraft.

(2) Gain access to yaw damper control box located between frames 8 and 9 at LBL 7.

(3) Disconnect electrical connector from yaw damper control box.

(4) Remove attaching parts and remove yaw damper control box.

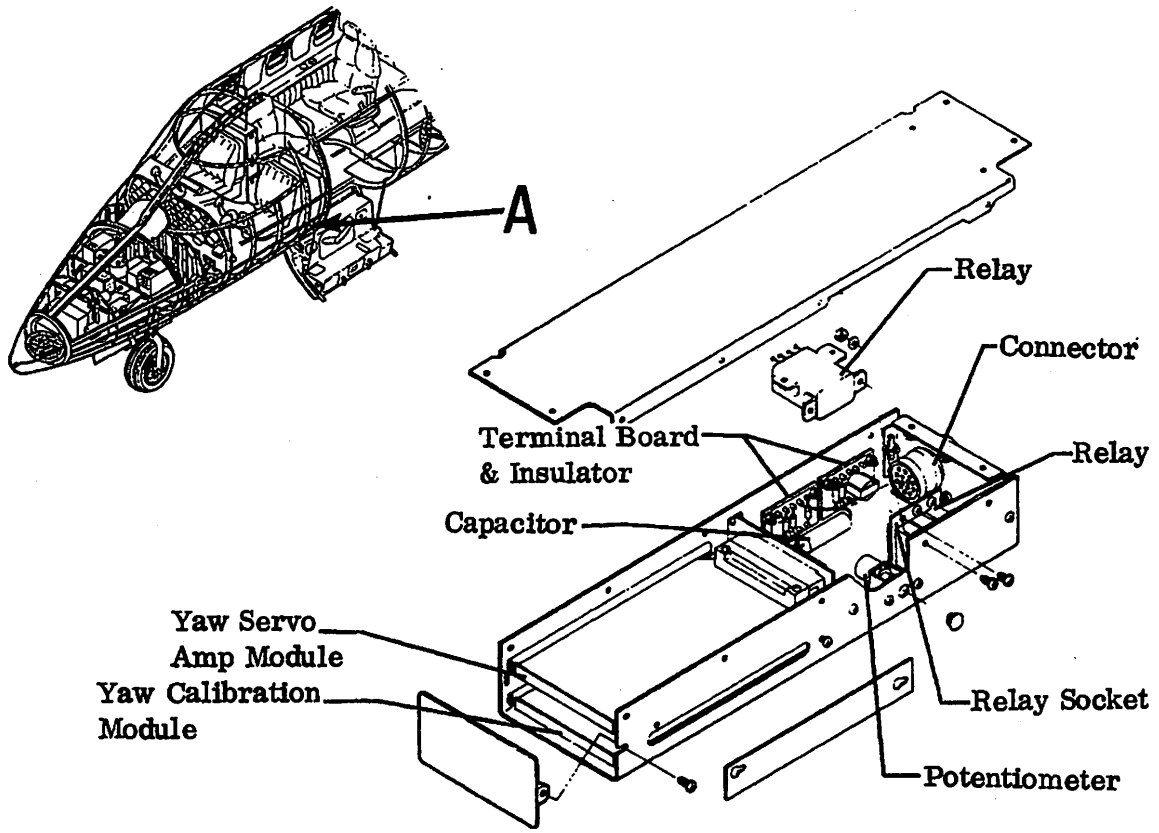
B. Install Yaw Damper Control Box (See figure 201)

(1) Place yaw damper control box in position and secure with attaching parts.

(2) Connect electrical connector to yaw damper controller.

(3) Install equipment removed to gain access to yaw damper control box.

(4) Restore electrical power to aircraft.



9-111C

Yaw Damper Control Box Installation
Figure 201

YAW DAMPER FORCE SENSOR SYSTEM - DESCRIPTION AND OPERATION

1. Description
   - A. The yaw damper force sensor system consists of two yaw damper force sensors and a yaw damper force detector box.
   - B. Component Description
     - (1) Two yaw damper force sensors (one each for the pilot and copilot) are attached between the rudder pedal bellcrank and the forward rudder bellcrank.
     - (2) The yaw damper force detector box is located below the copilot's seat.

2. Operation
   - A. The yaw damper force sensor system provides a means by which the aircraft may be flown in all phases of flight (including final approach, touchdown, and rollout), within the flight envelope, with the yaw damper engaged.
   - B. Normal flight conditions (yaw damper engaged and feet off rudder pedals) produces no load on the yaw damper force sensors. The pilot or copilot must resist rudder pedal movement or initiate override load on the rudder pedals to provide a load on the yaw damper force sensor.
   - C. When a force of 30 pounds is applied to the rudder pedals, the yaw damper force sensor electrically notifies the yaw damper force detector box. The yaw damper force detector box then switches the yaw damper system to a low override torque configuration. The yaw damper force detector box will wash out (follow) to the established rudder position. The yaw damper system switches back into normal operation when the overrride force is released from the rudder pedals.

YAW DAMPER FORCE SENSOR SYSTEM - MAINTENANCE PRACTICES

1. Inspection/Check

A. Perform yaw damper force sensor system operational check as follows:

(1) Connect external power unit to aircraft. Apply 28 vdc power to the aircraft.

(2) Set Battery Switches on.

(3) Set either PRI INVERTER or SEC INVERTER Switch on.

(4) Depress YAW DAMPER - ON pushbutton, located on the autopilot control panel.

(5) Using a push-pull scale, push down on the pilot's left rudder pedal. Observe that the yaw damper force indicator needle begins to deflect to the left when the scale reaches 30 (±6) pounds. Continue to push down on the rudder pedal until the yaw damper force indicator needle deflects to half scale left.

(6) Release force on rudder pedal. Observe that the yaw damper force indicator needle slowly moves to the center position as the yaw damper force detector box switches the yaw damper systems back into operation.

(7) Using a push-pull scale, push down on the copilot's right rudder pedal. Observe that the yaw damper force indicator needle begins to deflect to the right when the scale reaches 30 (±6) pounds. Continue to push down on the rudder pedal until yaw damper force indicator needle deflects to half scale right.

(8) Release force on rudder pedal. Observe that the yaw damper force indicator needle slowly moves to the center position as the yaw damper force detector box switches the yaw damper system back to normal operation.

(9) Depress YAW DAMPER - OFF pushbutton, located on the autopilot control panel.

(10) Set both Inverter Switches off.

(11) Set Battery Switches to OFF.

(12) Set external power source control switch to off and disconnect external power source from the aircraft.

YAW DAMPER FORCE DETECTOR BOX - MAINTENANCE PRACTICES

1. Removal/Installation

A. Remove Yaw Damper Force Detector Box

(1) Remove electrical power from aircraft.

(2) Remove copilot's seat. (Refer to Chapter 25.)

(3) Disconnect electrical connector from yaw damper force detector box.

(4) Remove attaching parts and remove yaw damper force detector box.

B. Install Yaw Damper Force Detector Box

(1) Position yaw damper force detector box under copilot's seat and secure with attaching parts.

(2) Connect electrical connector to yaw damper force detector box.

(3) Perform yaw damper force sensor system operational check. (Refer to 22-51-00.)

(4) Install copilot's seat in aircraft. (Refer to Chapter 25.)

(5) Restore electrical power to aircraft.

YAW DAMPER FORCE SENSOR - MAINTENANCE PRACTICES

1. Removal/Installation

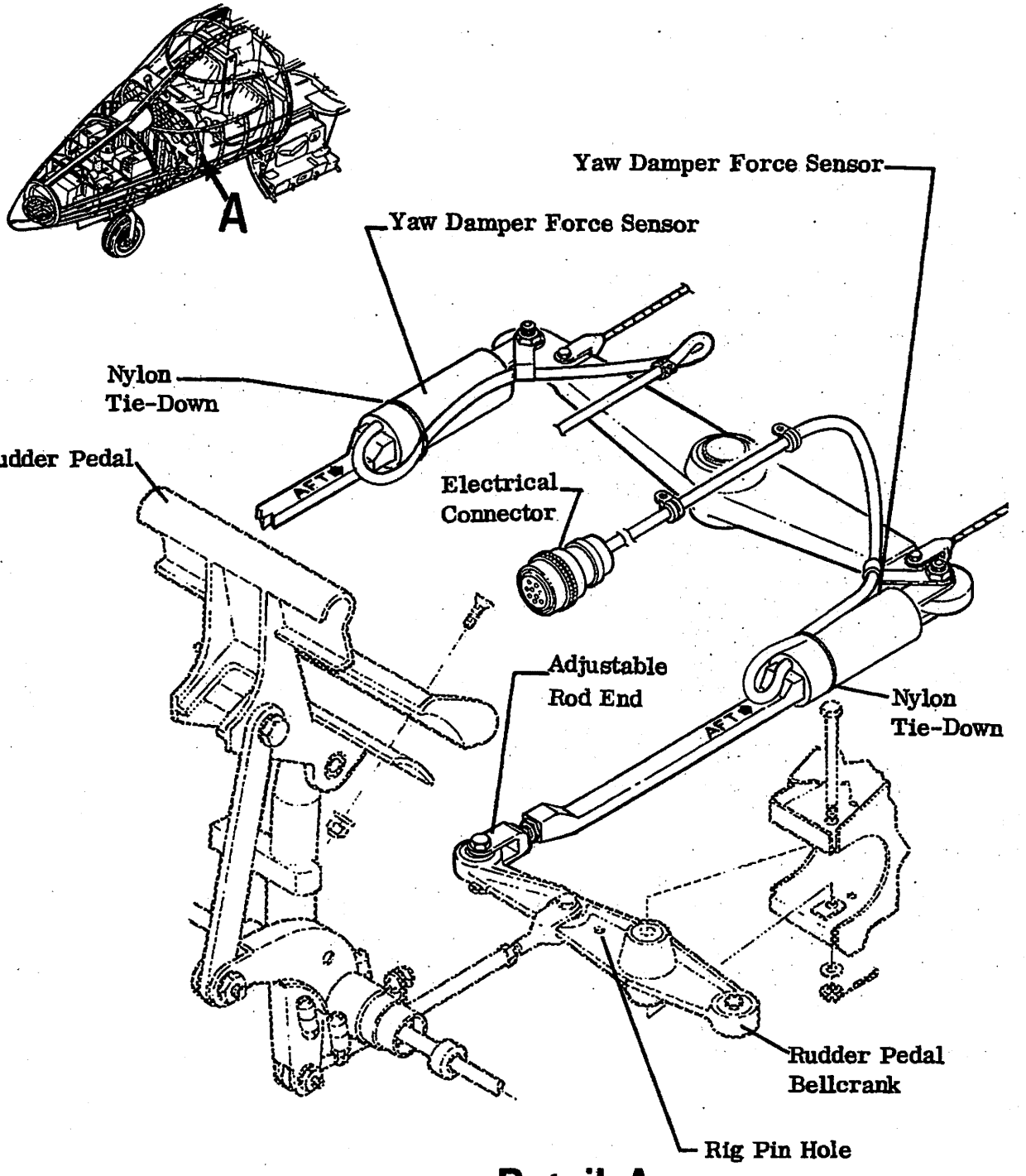
A. Remove Yaw Damper Force Sensors (See figure 201.)

(1) Remove pilot's and copilot's seats. (Refer to Chapter 25.)
(2) Remove cockpit floorboards between rudder pedals and frame 8.
(3) Place rudder pedals in neutral position and install 0.25-inch diameter rigging pin in rudder pedal bellcrank.
(4) Remove nylon tie-down which holds electrical wire to force sensor.
(5) Disconnect electrical connector from yaw damper force sensor.
(6) Remove attaching parts from each end of yaw damper force sensor and remove force sensor.

B. Install Yaw Damper Force Sensors (See figure 201.)

NOTE: With rudder pedals in neutral position, it may be necessary to adjust the adjustable rod end of the yaw damper force sensor.

(1) Place yaw damper force sensor in position and secure with attaching parts.
(2) Connect electrical connector to yaw damper force sensor.
(3) Install nylon tie-down to hold electrical wiring in place.
(4) Rig rudder control system. (Refer to Chapter 27.)
(5) Remove rig pins.
(6) Perform yaw damper force sensor system operational test. (Refer to 22-51-00.)
(7) Install cockpit floorboards.
(8) Install pilot's and copilot's seats.



Detail A

8-69C-2

Yaw Damper Force Sensor Installation
Figure 201